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A New Prescription: Pollution Prevention Strategies for the Health Care Industry

Wednesday, October 7, 1998

Boston University Corporate Education Center
Tyngsborough, Massachusetts

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Massachusetts Executive Office of Environmental Affairs
Office of Technical Assistance for Toxics Use Reduction
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Massachusetts Strategic Envirotechnology Partnership
Massachusetts Water Resources Authority
Medical Academic and Scientific Community Organization
U.S. Environmental Protection Agency – New England

EXECUTIVE OFFICE of ENVIRONMENTAL AFFAIRS
MASSACHUSETTS WATER RESOURCES AUTHORITY
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Region 1, New England

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A New Prescription: Pollution Prevention Strategies for the Health Care Industry

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Proceedings

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U.S. Environmental Protection Agency – New England

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About the Sponsors:

Massachusetts Executive Office of Environmental Affairs, Office of Technical Assistance for Toxics Use Reduction (OTA) provides manufacturers and institutions that use toxic materials with non-regulatory, confidential technical assistance on opportunities to reduce the use of toxic materials or the generation of toxic byproducts. 100 Cambridge Street, Room 2109, Boston, Massachusetts 02202. Phone: (617) 727-3260. Fax: (617) 727-3827. Web Page: Http:\\www.magnet.state.ma.us\ota.

Massachusetts Department of Environmental Protection (DEP) is the state agency responsible for ensuring clean air, water, and land through pollution prevention and toxics use reduction, safe management of solid and hazardous wastes, timely cleanup of hazardous waste sites and spills, and preservation of wetlands and coastal resources across Massachusetts. 1 Winter Street, Boston, Massahusetts 02108. Phone: (617) 292-5500. Web Page: Http:\\www.magnet.state.us\dep.

Massachusetts Strategic Envirotechnology Partnership (STEP), supports the growth of new environmental and energy efficient technologies in Massachusetts by offering a full range of coordinated state services to reduce the uncertainties leading to the successful commercialization of such innovative technologies. 100 Cambridge Street, Room 2000, Boston, Massachusetts 02202. Phone: (617) 727-9800. Web Page: http://www.magnet.state.ma.us/envir/eoea.htm

Massachusetts Water Resources Authority (MWRA) supplies water to 46 municipalities and provides wastewater treatment services to 43 communities and 5500 businesses in the Greater Boston area. MWRA sponsors workshops, joint research projects with industry and innovative toxics control programs to encourage homeowners and industrial users to practice pollution prevention. Charlestown Navy Yard, 100 First Avenue, Boston, MA 02129. Phone: (617) 242-6000. http://www.mwra.state.ma.us

Medical Academic and Scientific Community Organization (MASCO) is a charitable corporation established to develop and provide support programs of a shared-service nature for our member institutions that help them to function in a more effective and efficient manner. Our member institutions include world-class medical and educational institutions located in the Longwood Medical and Academic Area (LMA) of Boston. MASCO offers a wide range of services, including group purchasing and shared service contracting for telecommunications, parking and transit, area planning and development, government and community relations, security, building management and child care. 375 Longwood Avenue, Boston, Massachusetts 02215. Phone: (617) 632-2310. Fax: (617) 632-2759. Http://www.masco.org

U.S. Environmental Protection Agency - New England (EPA-Region I) is the federal agency serving Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island and Vermont whose mission is to protect human health and safeguard and improve the natural environment. One Congress Street, 11th Floor Boston, Massachusetts 02203. Phone: (617) 565-3300. Web Page: http://www.epa.gov/region01

About the Conference:

Since 1989 the Toxics Use Reduction Act of the Commonwealth of Massachusetts has required that manufacturing facilities that use large quantities of toxic chemicals must draw up plans for reducing toxics use. The Act also established the Office of Technical Assistance, to provide pollution prevention assistance to these facilities and to others that use toxic materials.

In 1997 the Massachusetts Toxics Action Center in conjunction with Physicians for Social Responsibility, held a Roundtable conference on Reducing Hospital Waste. Although OTA has provided assistance to several medical facilities, the event prompted the office to expand its efforts to promote toxics use reduction to this sector.

OTA then sought and received a grant from the U.S. Environmental Protection Agency to conduct this conference. MWRA, MASCO, DEP and STEP immediately agreed to participate, and EPA staff has continuously participated as well. During the past year, the partner organizations have jointly issued a call for papers, designed a survey for attendees, produced proceedings to be distributed at the conference, organized vendor exhibitions and contacted relevant agencies and organizations. Medical facilities are subject to many of the same environmental requirements as faced by heavy industry. The point of this conference is that there is much that medical facilities can do to reduce their own impact on the environment. By putting so much time and energy into this conference, and joining with OTA to provide assistance, enforcement agencies are clearly emphasizing the value of a cooperative approach. Please use this conference as a resource, and contact any of the partner organizations for further information. Speaker contact information is also included at the end of each paper.

Acknowledgements

At this time we would like to thank the following people for putting this conference together. Secretary Trudy Coxe, Barbara Kelley - Director of OTA, Rick Reibstein - Assistant Director of OTA, Scott Fortier, Lara Sutherland, Joe Paluzzi, Susan Lanza, Christopher MacIsaac, Sayaka Yamaki, Cynthia Barakatt, Audrey Tyler, and Timothy Karcz also of OTA, David Eppstein of MASCO, David Struhs – Commissioner and Judy Shope of the Massachusetts DEP, Kevin McManus – Director TRAC Division, Karen Rondeau, David Drain, and Walter Schultz of the MWRA, Lee McMichael and Abby Swaine of the U.S. EPA, and Evelyn Bain and Denise Garlick of the Massachusetts Nurses Association.

Cooperating Organizations

OTA would also like to thank the following cooperating agencies for their efforts in assisting with the preparations for this conference:

- *Baystate Clinical Lab Managers Association*
- *Greater Boston Physicians for Social Responsibility*
- *Health Care Without Harm*
- *Massachusetts Hospital Association*
- *Massachusetts Nurses Association*
- *New Hampshire Hospital Association*

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Executive Summary

Medical facilities currently face substantial challenges to keep costs down, elevate the quality of care, compete in the market place, and comply with increasingly stringent and varied regulations. Recently, environmental regulatory agencies have stepped up enforcement efforts aimed at the medical and dental sector; at the same time, growing environmental awareness among local communities has pressured hospitals to pay more attention to these issues.

Pollution prevention (P2), defined as reducing the amount of toxic material going into a process from the beginning, is the key to minimizing the environmental impact of any operation. Eliminating the use of particular toxic substances can make the process safer for the health care professionals, the patients, and the environment. Changing a procedure to create less toxic waste can also save money through decreased disposal, transportation, and purchasing costs.

Because pollution prevention measures are not end-of-pipe solutions, all health care professionals and support staff must participate in the implementation of these changes. Here we present the experience of people who work in health care and have been involved in the implementation of pollution prevention programs at various types of facilities--dental offices, large hospitals, clinical laboratories, and smaller facilities.

The first papers provide an overview of environmental issues related to health care facilities and address current available solutions. Evidence indicates that medical facilities are significant sources of mercury and dioxin in the environment. Many replacement technologies are available, including mercury-free equipment and PVC-free supplies. Strategies such as waste auditing, employee education, and changed purchasing decisions have been implemented at a variety of facilities and can be used to make a significant and measurable change in the environmental impact of medical and dental care.

The facility-based papers cover a wide range of topics, including strategies for determining structural sources of mercury, procedures for initiating behavior change, and detailed descriptions of facility-wide programs for waste minimization and pollution prevention. Facility-wide cooperation must be achieved for a pollution prevention program to achieve success. Clinical staff must be consulted before supplies and equipment can be replaced. Alteration of waste segregation procedures at the source also requires the participation of all personnel.

Clinical laboratories use a myriad of reagents, many of which contain toxic chemicals as ingredients or contaminants. Strict analysis of contaminants in reagents may be required to assess the environmental impact of disposing of spent reagents. Because the accuracy of diagnostic tests is paramount, replacing reagents must be accompanied by validation testing and training of personnel. Although these procedures may seem prohibitively complex, many laboratories have already accomplished significant reduction in the use of reagents containing toxic chemicals.

Dental procedures involving amalgam can introduce mercury into the wastewater coming out of an office as well as generate significant heavy metal waste. Successfully reducing the amount of mercury entering the environment from dental offices requires the combination of upstream pollution prevention procedures as well as end-of-pipe controls. Cooperation between local wastewater treatment facilities and dental offices can lead to successful solutions to the mercury problem.

The development of effective management and education programs can be crucial in implementation of pollution prevention programs. Tools such as Total Quality Management (TQM) can be used to reduce waste and ensure compliance with new pollution prevention policies and procedures at any facility.

A resource list is included in the proceedings to aid all those who wish to implement pollution prevention programs at their office, facility, or organization. Web Sites, technical assistance providers, resource centers, relevant organizations, articles, books, and periodicals are all included and organized by topics. This publication is intended to help all interested persons and organizations institute wide-ranging pollution prevention programs, and ultimately reduce the environmental impact of all health care operations.

Section 1: Plenary Session

Laura Brannen
Waste Minimization Coordinator
Dartmouth-Hitchcock Medical Center (DHMC)

How to Make Changes - A Panel Discussion

Why Do Healthcare Facilities Need A Waste Management Program?

The DHMC new employee orientation "Environmental Programs" talk begins with a tour of the Waste Management Center with dazed new staff asking, "Why are they dragging me down here on my first day at work?" Then I explain that everyday tons of trash pass through these doors. Everyday, a ton of infectious waste is autoclaved and "managed," tons of paper are shredded, and a ton or so of beverage containers, batteries, light bulbs and other recyclables is sorted. These new employees start to shake their heads in understanding as I explain that every one of them has some responsibility for the waste and recyclables that enter this room.

We go back to the conference room where we continue to talk about the need for hospitals to "change the culture" in waste management. No longer is an "out-of-site, out-of mind" approach to waste management appropriate for health care. It is time for the industry to take some responsibility in managing the mounds of waste it generates, and even more importantly, reducing the *toxicity* of that waste. It is time for health care to make the connection that pollution prevention is preventative medicine for the environment. The new staff nod their heads in agreement.

If It's Such a Good Idea, Why Isn't Everyone Doing It?

That's a good question, and one I hope time will address when the industry catches on and everyone IS doing it! But there have been several barriers in making the shift. An important one is that, at least in most states, many of these "environmental programs" are not compliance driven. Our jobs as waste managers would be much easier if state or federal regulations dictated recycling and waste minimization programs. But these programs are "overhead" – non-clinical programs that are often the first to get scrapped in budget cuts or the last to get started when weighted against clinical priorities. It's a tough sell.

The fact is, however, that waste management programs are cost effective. Take red bag waste reduction for example – major health care facilities that have embarked upon reduction initiatives to reduce this costly waste stream have saved money. I won't get into a detailed analysis, but the data is available and the savings speak for themselves. As waste managers, most of us are trash pickers from way back and we know what's going out the door. We are in an excellent position to address the instances where we are literally tossing resources – and then address work practice issues to reduce the unnecessary disposal of these resources. There are many examples. Monitoring infectious sharps containers, we found usable instruments disposed in the containers. Working with Central Sterile Reprocessing, we put together an education program to "eliminate" this practice. We also found unopened medical supplies in the trash.

Laura Brannen
Waste Minimization Coordinator
Dartmouth-Hitchcock Medical Center (DHMC)

Nurses, unit assistants and housekeepers used to toss all the supplies left in a patient room at discharge, whether they were open or not. Working with a nursing task force, we developed guidelines for medical supplies disposition: what should be restocked, what is appropriate for 3rd world distribution and what must be disposed.

Actually, there is an important point to be made -- not all environmental programs are cost effective, like disposing of hazardous wastes, or fluorescent light bulbs, or batteries. At an average disposal cost of $3000/ton, hazardous waste is clearly expensive. Sure we can minimize the costs with reduction initiatives (another job for an environmental manager), but these are the costs of doing business. We need to expand this notion beyond compliance.

Other Barriers?

Old paradigms regarding how purchasing decisions are made may be barriers to choosing more environmentally sound products. It's the bottom line vs. life cycle analysis. For example, a mercury thermometer may only cost $1 (or less), but we must include not only the actual disposal costs for that same thermometer ($2-$4 per) but also the environmental and human health impacts. And what are the costs of a mercury management program, or of cleaning a broken thermometer? Taking these other considerations into account, purchasing a $5 digital or other more expensive devices doesn't seem so unrealistic.

Group purchasing organizations (GPOs) – are they a barrier? When we would like to consider an alternative product but we've just signed an 8-year contract on a variety of products, that's a barrier. But if the industry, collectively, demands that GPOs supply environmentally sound products in terms of reduced toxicity, appropriate packaging, reasonable disposal options, maybe this current barrier can be an opportunity.

And Besides, Who is Going to Do It?

Waste Managers come from Housekeeping, Engineering, Safety, Facilities, or from the clinical side. The field is too new and the jury is still out on the "best" system. There are many niches for people to fill -- housekeeping and engineering departments are more likely to be involved developing and managing recycling and waste management programs. Hazardous waste technicians or safety folks can address toxicity issues while nurses and clinicians may focus on how work practices impact the environment and consequently affect public health issues. In a "perfect" system, they all take some ownership of and support all programs. The most successful programs, however, are those that have a dedicated waste or environmental programs manager.

Laura Brannen
Waste Minimization Coordinator
Dartmouth-Hitchcock Medical Center (DHMC)

Start on the Path of Least Resistance – But Start Somewhere and Start Now!

Where to start or where to expand is difficult to definitively advise. Obviously, the decisions are based on resources, the culture of your facility and community, or even what is happening at the state regulatory level. While the "health care without harm" focus is on reducing the toxicity of hospital waste, some facilities may find it easier to implement recycling and general waste management programs first. Since all staff generate waste, and many recycle in their communities, recycling and waste minimization is a language that is familiar and thus may be easier to get off the ground. A hospital may be more likely to be receptive to "enhanced" programs like pollution prevention initiatives if they have successful waste management programs. They do overlap, however, and ideally can happen simultaneously. The "sustainable hospital model" certainly incorporates any environmental initiative – where you start may just depend on where you find the path of least resistance.

There are two basic approaches to developing a dedicated "environmental program." Both have been tried and so far, both are working. The first is the "top down" model. First administrative support is garnered. An environmental mission statement is written and implemented, strategies for improvement are planned, and then the programs are implemented.

The second approach is more the "bottom up" model where Housekeeping, for instance, may take the lead in starting a recycling program, or Dietary may start a composting program. Other potential programs are prioritized and implemented as resources allow. Successes are documented and the programs grow to the point where a facility-wide mission statement that fits the current level of commitment is developed and programs are expanded accordingly.

Ask Questions, Get Educated – Make Changes

Where do you start? A simple waste audit should be conducted to find answers to some of the following questions to find the areas where improvement can be achieved most easily or where the biggest benefits can be realized.

- What are the volumes of all major waste streams: solid waste, recycling, infectious waste, and hazardous waste?
- How much medical waste is generated? How is it treated? What are the source segregation programs in place?
- Hazardous Waste Management Program - who is responsible (who signs the manifests)? Does your facility have a hazard communication policy that addressed hazard reduction?
- Where is mercury being used (thermometers, sphygmomanometers, chemicals, Miller Abbot Tubes, bugies, dilators)? How is it disposed? Do we have a Mercury Management Policy? A spill clean-up procedure?

- What about batteries? Fluorescent light bulbs?
- PVC: what products contain PVC? How are they disposed?

Medical Waste Disposal

Other authors explore the negative impacts of incineration of medical wastes on human health and the environment. I will not elaborate beyond the fact that incineration is no longer the preferred method of treatment - alternatives exist that are less harmful, and more cost effective. Making the right choice between the alternatives, such as thermal and chemical treatment, autoclave, microwave, high temp. electric arc, shredding technologies, will depend upon the following parameters:

- Technology – Is there confidence in the current technology? What is the track record of the technology, company, and servicing? Check references.

- State regulations – check local regulations from landfilling to air testing. Some states require shredding technologies after treatment.

- On-site or off-site treatment – preference for on-site treatment for instance, may limit choices but may also be cost effective if local choices are limited, or hauling costs are prohibitive.

- Operations – Check safety and maintenance records. For off-site alternatives, thorough site assessments are critical – does the company have any violations? Environmental issues – consider air, water emissions, and compliance testing costs

- Cost Benefit Analysis – As well as the obvious considerations (testing costs, compliance costs, energy, labor, hauling, etc), if you're generating more than 15% medical waste, include medical waste minimization savings in the benefit analysis. Not that you couldn't do minimization even if you didn't change technology – but these savings bringing the generation rate to 15% could be substantial and should be part of the analysis.

DHMC Experience

DHMC operated an on-site incinerator at its new site from 1990-1995. In August of 1995, the chimney began deteriorating after its mortar between the tiles/bricks began cracking from thermal shock. In order to fire the incinerator back up, significant investment was required to re-build the chimney with appropriate air pollution devices, to comply with the new air monitoring and ash testing standards. After addressing the issues listed above, 2 - 150lb/hour autoclave units were purchased and a full-blown educational effort was underway. We reduced our generation rates from 40% to 14% saving over $150,000 per year.

Laura Brannen
Waste Minimization Coordinator
Dartmouth-Hitchcock Medical Center (DHMC)

Education is the KEY

Employee education is the main function of any waste or environmental programs coordinator. If staff do not know the environmental or human health impacts of their actions, they are not going to comply. They need to know their individual work practices are making a difference. Physicians and nurses should know how the medical waste they generate is treated – or what the consequences of tossing a mercury filled "Miller Abbott Tube" in the garbage will be: landfilled or worse, incinerated.
Housekeepers have a big role to play – they see it all. Empower them to have a voice to help identify problem areas and assist in educating staff. Laboratory staff are an obvious target to reduce hazardous waste generation. Engineering is also a heavy user of hazardous chemicals from pesticides to paints and other chemicals. And Purchasing holds the key to materials coming in the door, and will need to be educated about their potential roles in working with vendors and manufacturers to bring in less toxic materials, less packaging, PVC free supplies, etc.

Talking Trash ???

DHMC has had a great deal of success with its waste management and environmental programs – but we have not "arrived". There is much more work to be done in the areas of PVC reduction, pollution prevention, materials reduction and reuse… the list is endless. Staff care about these programs and want to feel good about the role their community health care facility is playing in protecting their environmental health, but recognizing the demands of a busy clinic or inpatient unit, and then being asked to "reuse, reduce, recycle, eliminate…" when possible is a balancing act.

Pollution prevention is a moral obligation healthcare has to its communities. These programs are achievable, sustainable, and necessary.

***Laura Brannen** developed, implemented, and manages the Dartmouth-Hitchcock Medical Center's waste management program. Her work includes development of waste minimization programs, recycling program implementation and ongoing development, and waste management employee education. Ms. Brannen also develops buy-recycled and pollution prevention programs, and prior to this, was the hazardous materials technician. She can be contacted at the Dartmouth-Hitchcock Medical Center, Lebanon, New Hampshire 03756. Phone: (603) 650-7488. E-Mail: Laura.F.Brannen@Hitchcock.org.*

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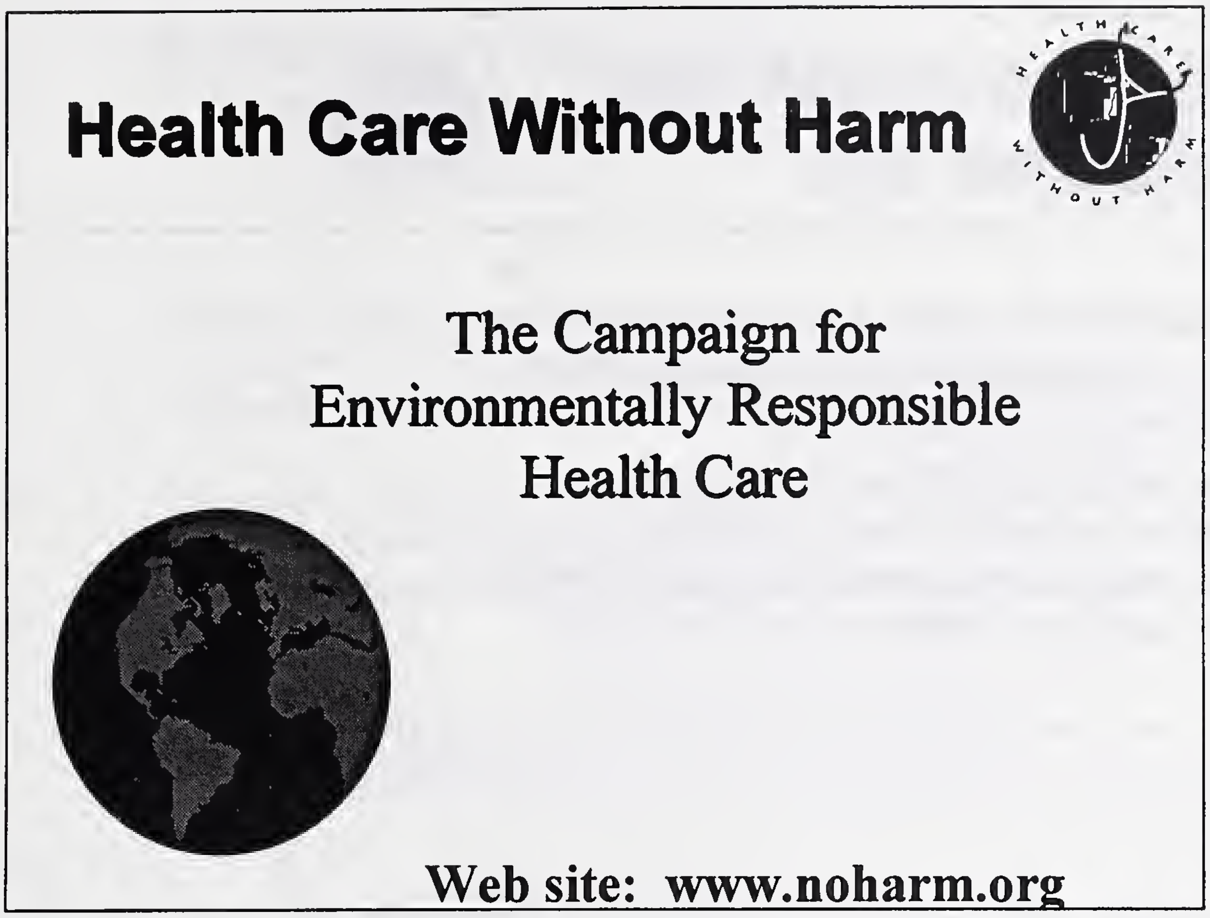
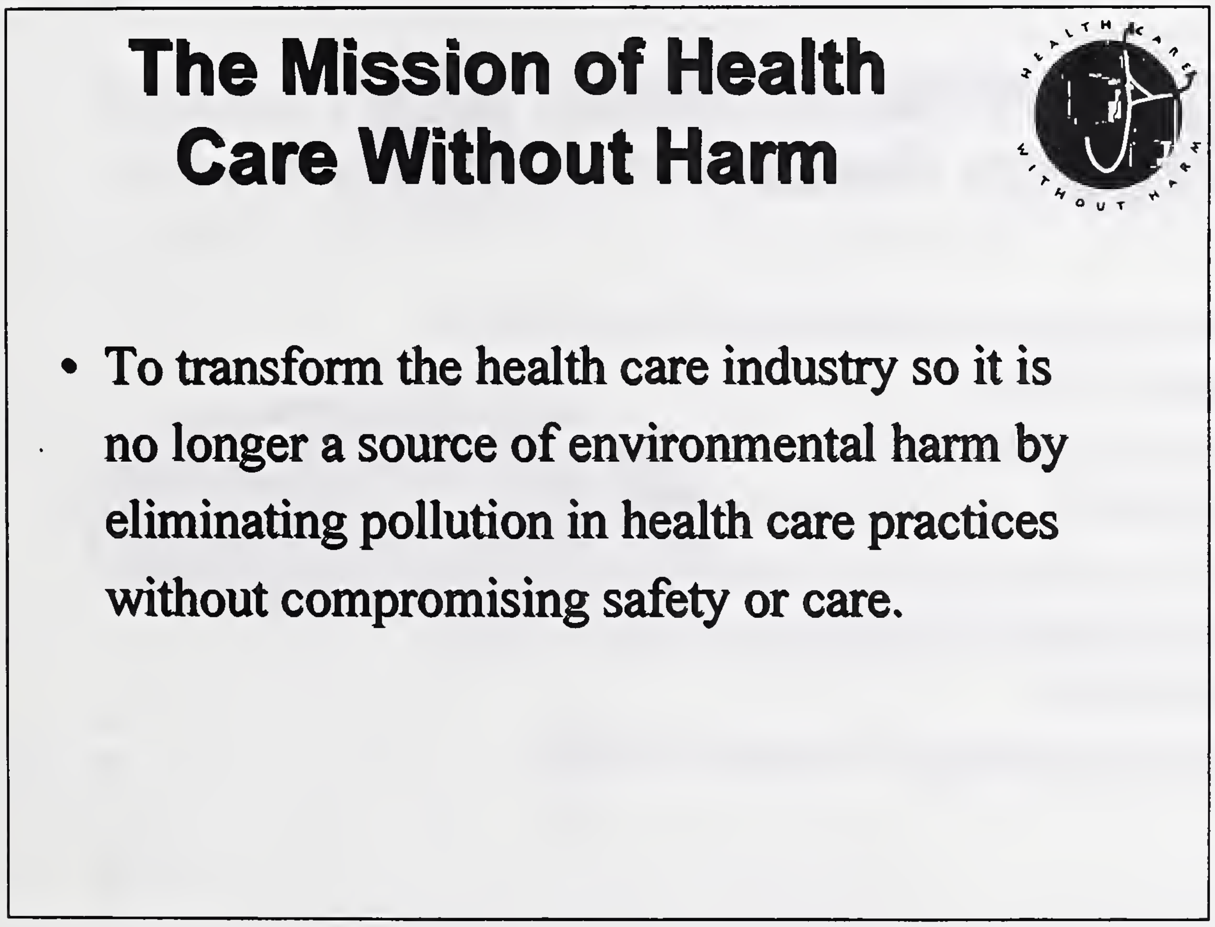


Health Care Without Harm

The Campaign for
Environmentally Responsible
Health Care

Web site: www.noharm.org



The Mission of Health Care Without Harm

- To transform the health care industry so it is no longer a source of environmental harm by eliminating pollution in health care practices without compromising safety or care.

Gary Cohen
Health Care Without Harm
Jamaica Plain, Massachusetts

We will accomplish this mission by:

- Promoting comprehensive pollution prevention practices.
- Supporting the development and use of environmentally safe materials, technology and products.
- Educating and informing health care institutions, providers, workers, consumers, and all affected constituencies about the environmental and public health impacts of the health care industry and solutions to its problems.

Health Care Without Harm Campaign Goals

- To work with a wide range of constituencies for an ecologically sustainable health care system
- To eliminate the non-essential incineration of medical waste and promote safe materials use and treatment practices
- To phase out the use of PVC (polyvinyl chloride) plastics and persistent toxic chemicals and to build momentum for a broader PVC phase out campaign
- To phase out the use of mercury in the health care industry

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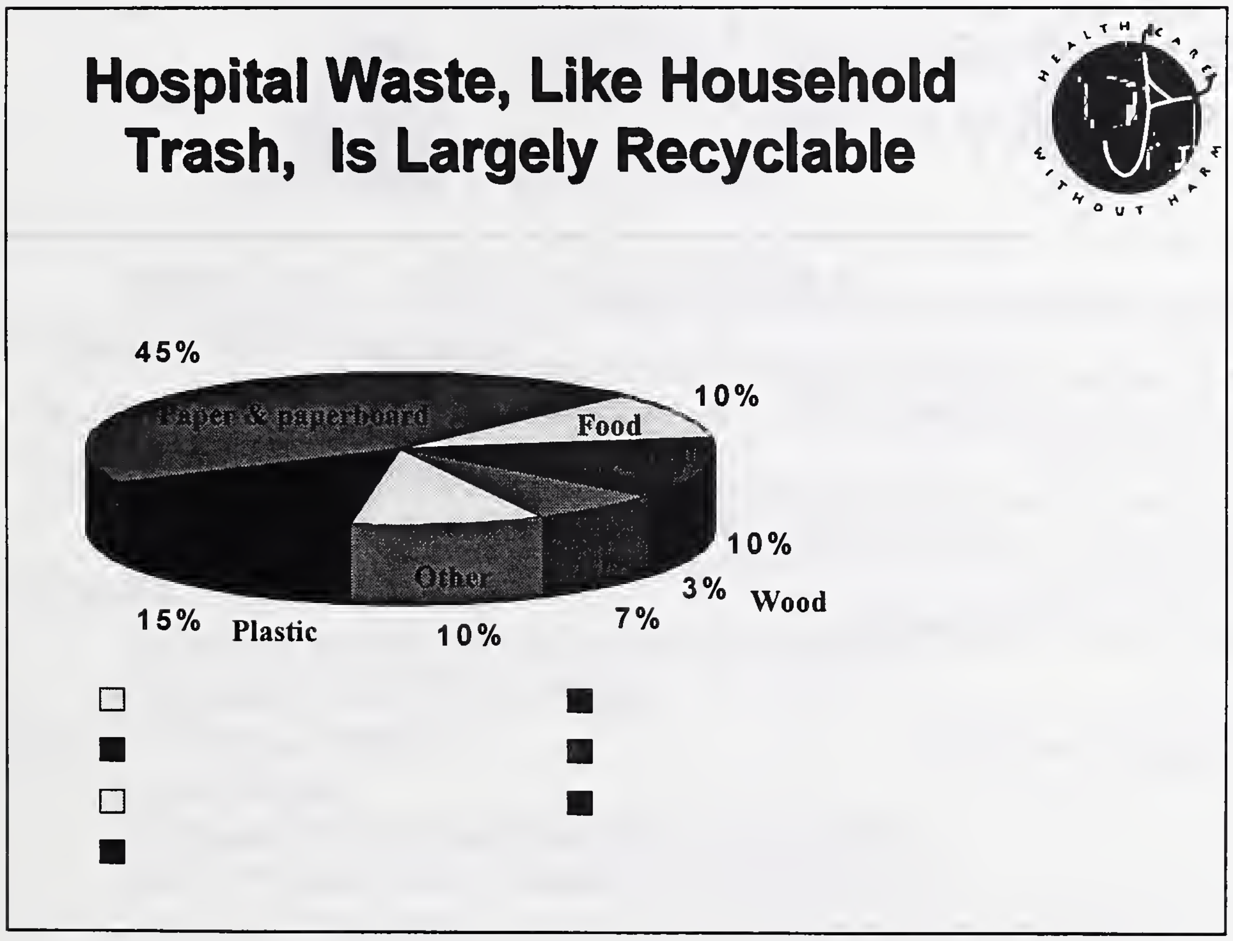
Health Care Without Harm Campaign Goals

(continued)

- To develop health-based standards for medical waste management and to recognize and implement the public's right to know about chemical usage in the health care industry.
- To develop just siting and transport guidelines that conform to the principles of environmental justice:
  "no communities should be poisoned by medical waste treatment and disposal"
- To develop an effective collaboration and communication structure among campaign allies.



Hospital Waste, Like Household Trash, Is Largely Recyclable

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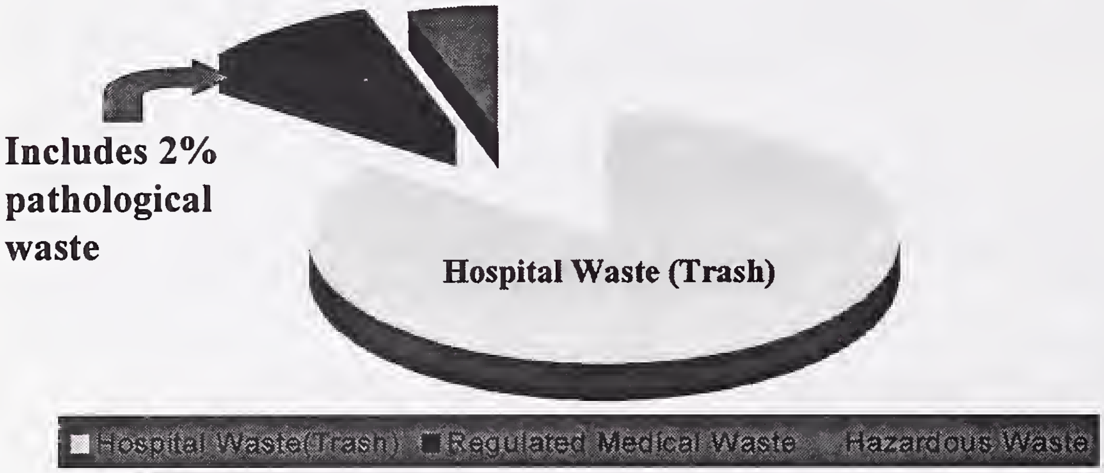
Jamaica Plain, Massachusetts

Most Hospital Waste Is Simply "Trash"



Definition of Regulated Medical Waste by AORN*

- Cultures and stocks of infectious waste
- Animal waste, bedding & carcasses in contact with infectious agents
- Waste from Class 4 infectious agents - [certain highly virulent diseases, e.g., Lassa Fever]
- Sharps (used & unused)

American Operating Room Nurses

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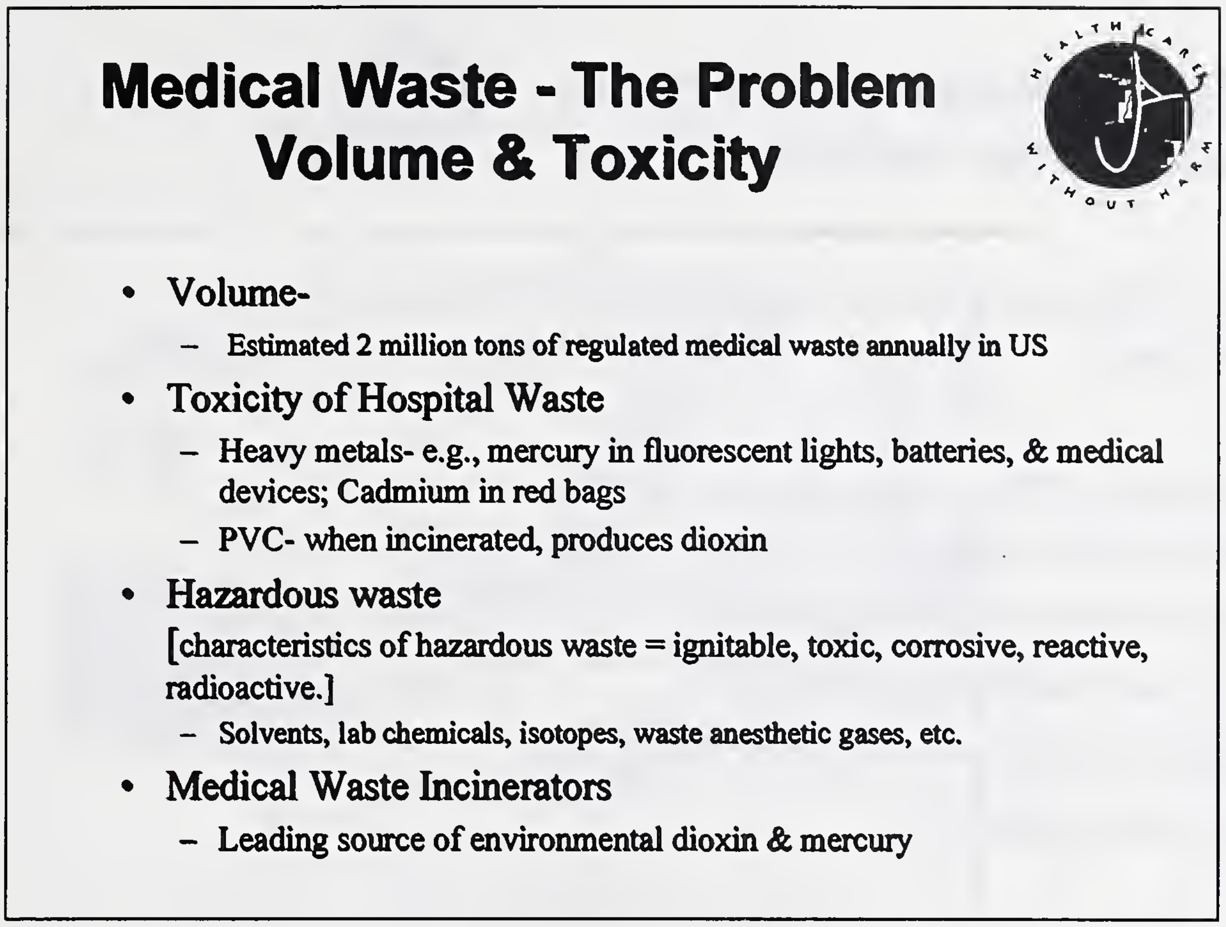
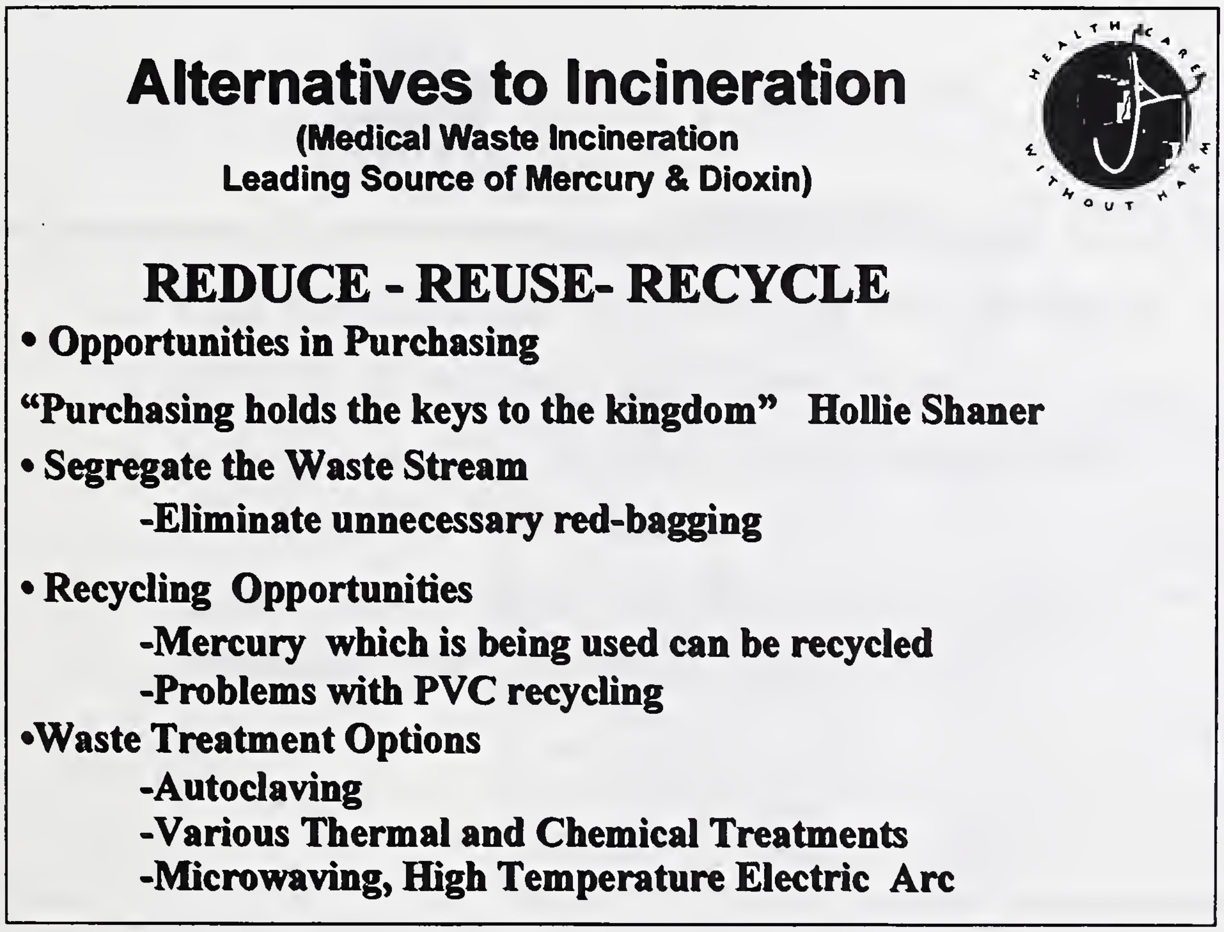
Jamaica Plain, Massachusetts



Medical Waste - The Problem
Volume & Toxicity

- Volume-
  - Estimated 2 million tons of regulated medical waste annually in US
- Toxicity of Hospital Waste
  - Heavy metals- e.g., mercury in fluorescent lights, batteries, & medical devices; Cadmium in red bags
  - PVC- when incinerated, produces dioxin
- Hazardous waste

  [characteristics of hazardous waste = ignitable, toxic, corrosive, reactive, radioactive.]
  - Solvents, lab chemicals, isotopes, waste anesthetic gases, etc.
- Medical Waste Incinerators
  - Leading source of environmental dioxin & mercury



Alternatives to Incineration

**(Medical Waste Incineration
Leading Source of Mercury & Dioxin)**

REDUCE - REUSE- RECYCLE

• Opportunities in Purchasing

"Purchasing holds the keys to the kingdom" Hollie Shaner

• Segregate the Waste Stream

-Eliminate unnecessary red-bagging

• Recycling Opportunities

-Mercury which is being used can be recycled

-Problems with PVC recycling

•Waste Treatment Options

-Autoclaving

-Various Thermal and Chemical Treatments

-Microwaving, High Temperature Electric Arc

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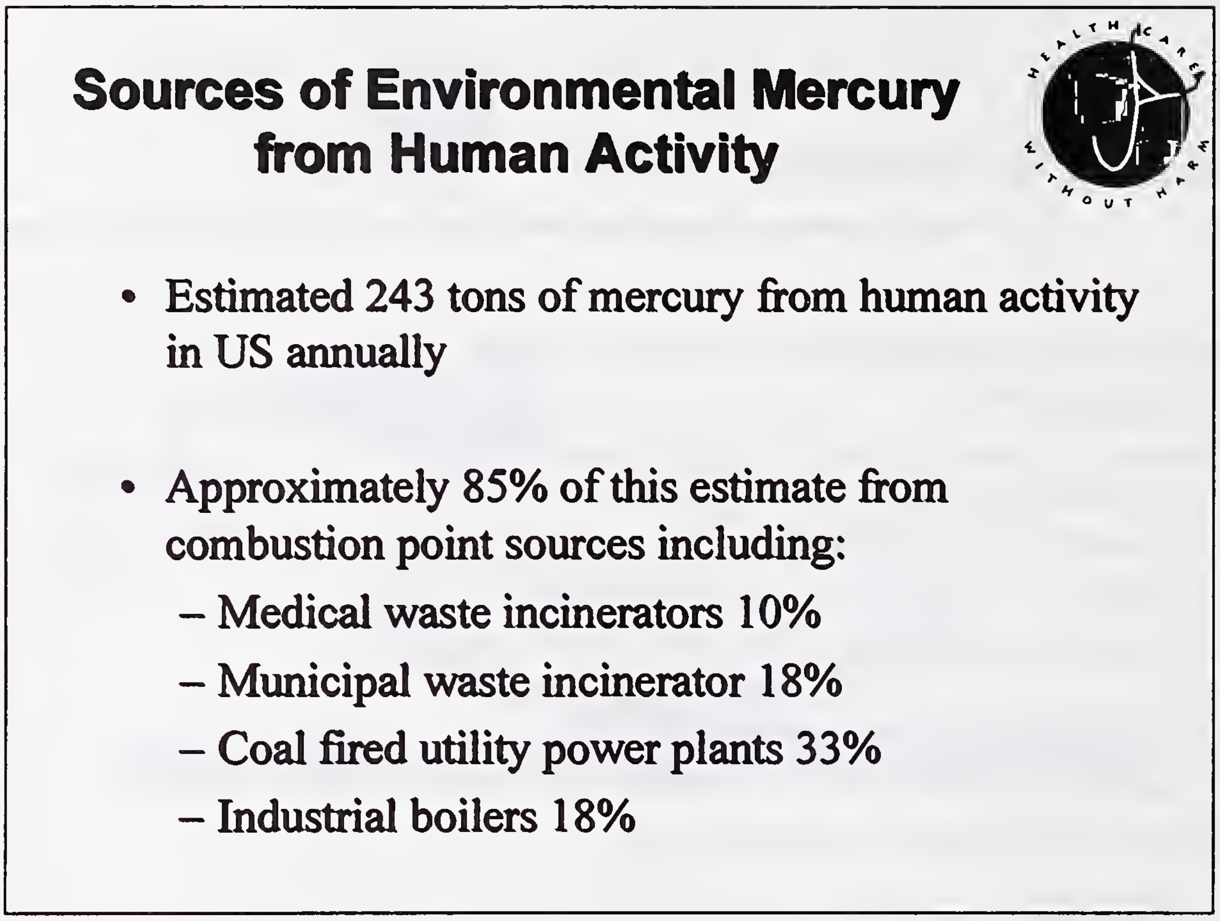
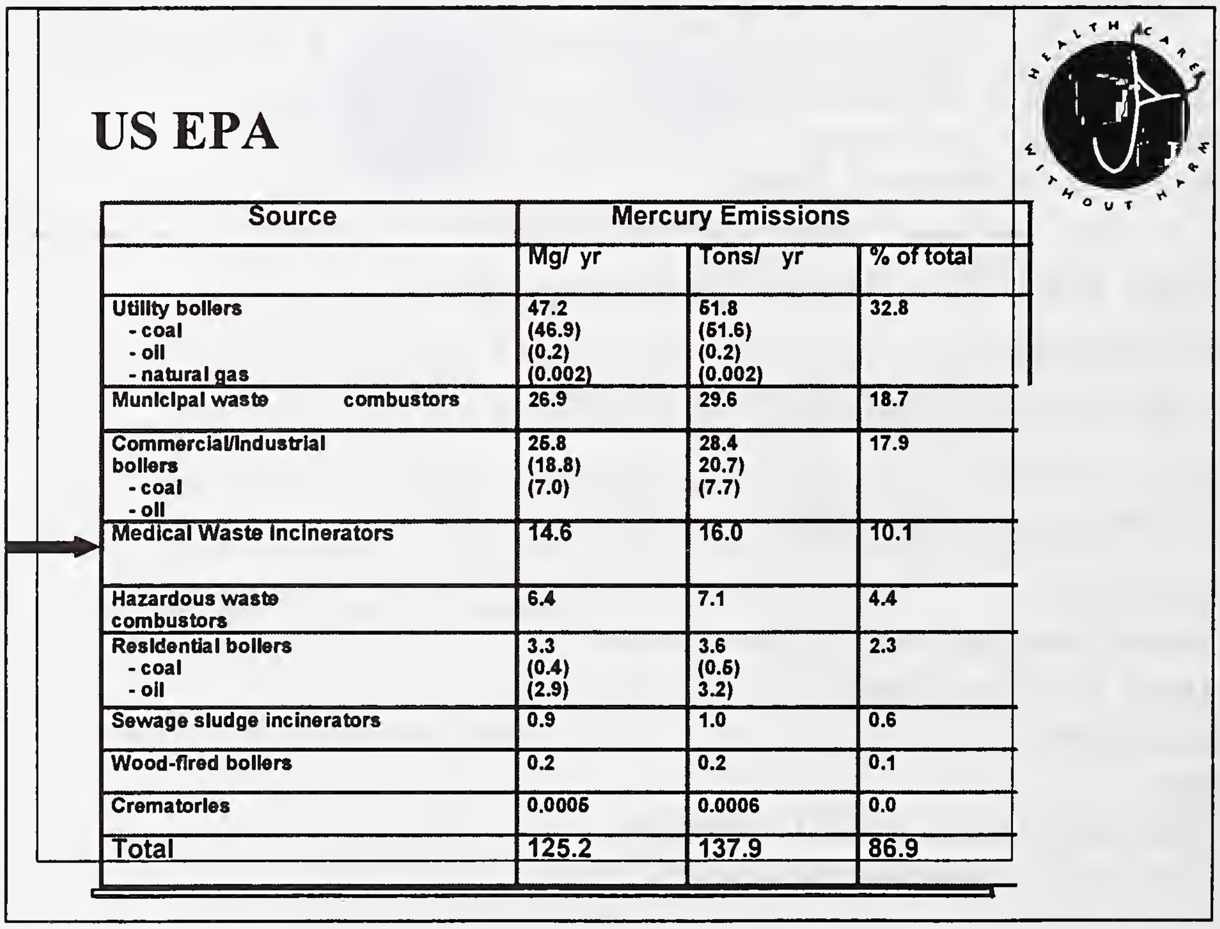
Jamaica Plain, Massachusetts



Sources of Environmental Mercury from Human Activity

- Estimated 243 tons of mercury from human activity in US annually
- Approximately 85% of this estimate from combustion point sources including:
  - Medical waste incinerators 10%
  - Municipal waste incinerator 18%
  - Coal fired utility power plants 33%
  - Industrial boilers 18%



US EPA

Source	Mercury Emissions		
	Mg/ yr	Tons/ yr	% of total
Utility boilers - coal - oil - natural gas	47.2 (46.9) (0.2) (0.002)	51.8 (51.6) (0.2) (0.002)	32.8
Municipal waste combustors	26.9	29.6	18.7
Commercial/Industrial boilers - coal - oil	25.8 (18.8) (7.0)	28.4 20.7) (7.7)	17.9
Medical Waste Incinerators	14.6	16.0	10.1
Hazardous waste combustors	6.4	7.1	4.4
Residential boilers - coal - oil	3.3 (0.4) (2.9)	3.6 (0.5) 3.2)	2.3
Sewage sludge incinerators	0.9	1.0	0.6
Wood-fired boilers	0.2	0.2	0.1
Crematories	0.0005	0.0006	0.0
Total	125.2	137.9	86.9

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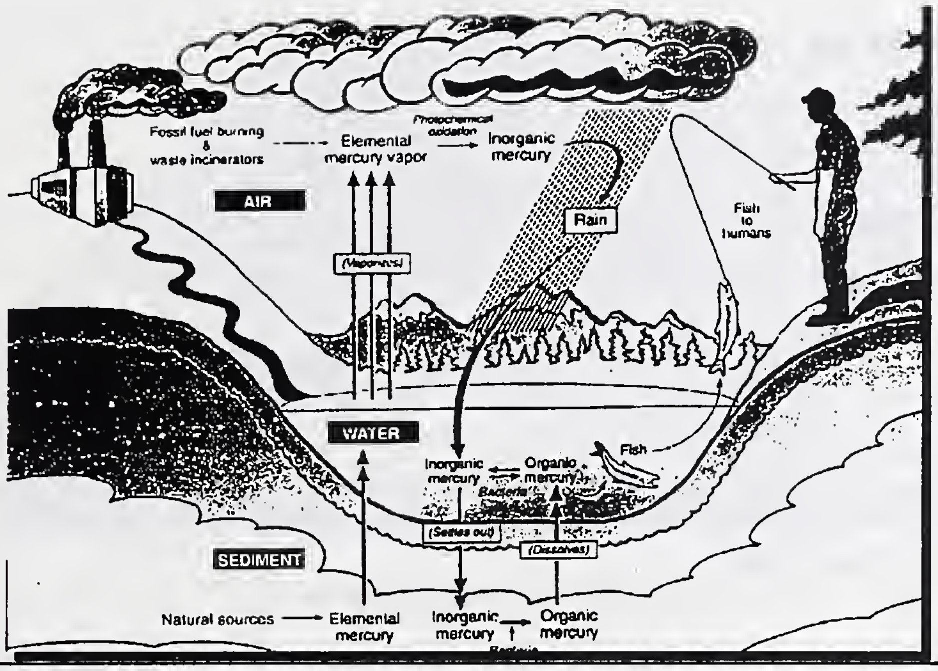
Mercury Cycle



Organic (Methyl) Mercury Exposure (Human)

- Fish consumption advisories in over 40 states because of mercury contamination.
- 5 million people regularly eat contaminated fish from the Great Lakes.
- Subsistence fishers and their children are at particular risk of adverse health effects.

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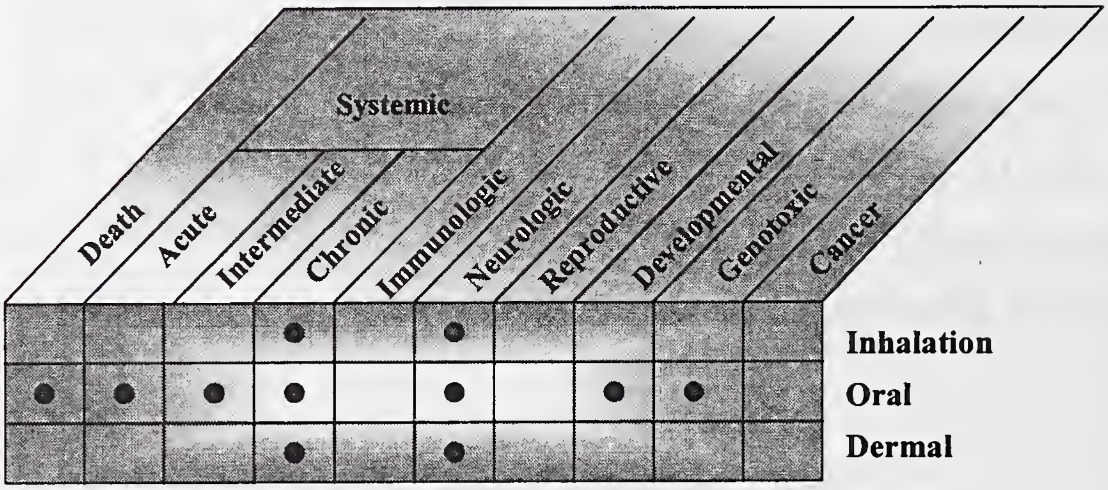
Mercury is A Potent Neurotoxin

Symptoms of Mercury Poisoning

- Impairment of peripheral vision
- Disturbance in sensations
- Lack of coordination of movements
- Impairment of speech or hearing
- Muscle weakness
- Skin rashes
- Mood swings, mental disturbances
- Developmental-interferes w/ normal brain development; impaired memory, attention, & learning

Health Effects of Methyl Mercury on Humans



		Systemic								
	Death	Acute	Intermediate	Chronic	Immunologic	Neurologic	Reproductive	Developmental	Genotoxic	Cancer
Inhalation				●		●				
Oral	●	●	●	●		●		●	●	
Dermal				●		●				

● Existing Studies (ATSDR 1998)

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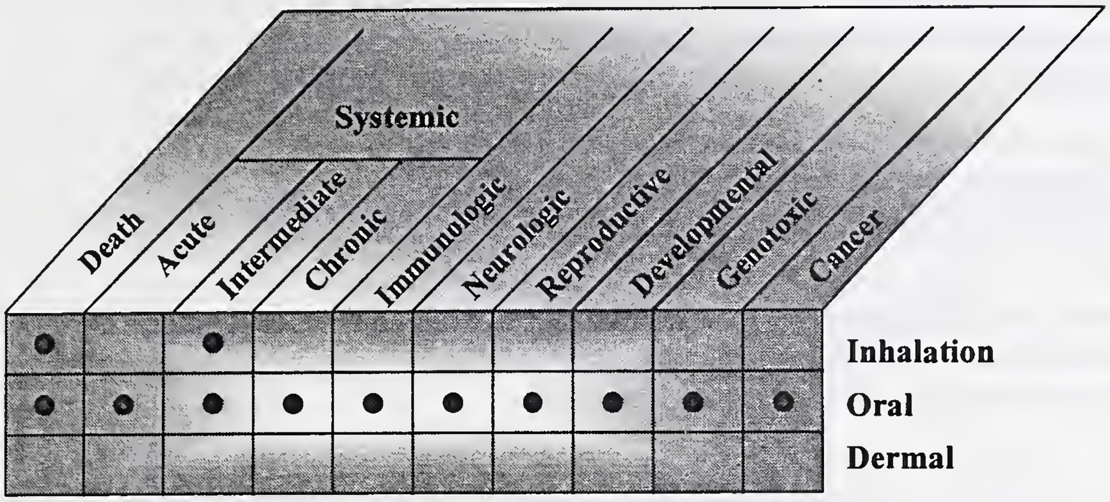
Health Effects of Methyl Mercury on Animals



		Systemic								
	Death	Acute	Intermediate	Chronic	Immunologic	Neurologic	Reproductive	Developmental	Genotoxic	Cancer
Inhalation	●		●							
Oral	●	●	●	●	●	●	●	●	●	●
Dermal										

● Existing Studies (ATSDR 1998)

Mercury in Health Care Organizations

The Obvious

- Thermometers
- Sphygmomanometers
- Miller-Abbott tubes
- Cantor tubes
- Esophageal bougies
- Laboratory Chemicals
- Thermostats
- Fluorescent lamps
- Batteries

The Not So Obvious

- Caustic Soda
- Laundry Chemicals-Bleach
- Antibacterial Soaps
- Boiler & Air Conditioning Chemicals
- Reagents
- Dental Amalgams (disposal issue)
- Plastics

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Mercury in Health Care Organizations

- Can mercury be eliminated altogether?
  - Yes. Alternatives exist for mercury based technologies.
- What would the benefits be?
  - Reduced occupational exposure to mercury, less mercury in medical wastes and in effluent water, less expense to organizations with mercury spill readiness plans and training.
- What are the obstacles?
  - Reluctance to change, lack of awareness of alternatives and economics, disposal costs of old mercury. Real challenges in the phase-out for discrete groups such as neonates, where accuracy is essential.

Health Care Products Containing Mercury (Hg) and Alternatives

• Product	• Alternatives
– Hg batteries →	– Lithium, zinc air, alkaline
– Esophageal devices, cantor & miller abbott tubes	– Products w/ tungsten tubing Anderson AN-20
– Hg thermometers	– Digital, expansion or aneroid
– Hg based blood pressure monitoring devices	– Electronic vacuum gauge, expansion or aneroid
– Lamps & lighting devices	– Non-Hg based-sodium vapor,glow lights, optical
– Hg switches	– Non-Hg switches
– Hg dental amalgams (disposal issue)	– Gold, ceramic, porcelain [hg in chemical analysis can be phased out in many cases]

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It Can Be Done !
Case Study / Butterworth Hospital,
Grand Rapids, Michigan
Mercury Abatement Policy

- The Purchasing Department will make every attempt to not purchase any product that contains mercury. This list of products includes, but is not limited to, sphygmomanometers, diffusion pumps, esophageal dilators, and mercury electrodes.
- The Purchasing staff will work with the requisitioning departments to find alternate products to acquire in place of the products that contain mercury. For example, disposable thermometers will be replaced by digital thermometers or disposable temperature strips. Mercury filled sphygmomanometers will be replaced with digital ones.
- The Environmental Services Director will be notified if the mercury containing product has to be purchased because there is no substitute product available.

Beth Israel Medical Center (BI), NYC
Reducing Wastes and Cutting Costs

- Janet Brown (Waste Manager) designed a red bag waste segregation program. She combined this with a rigorous monitoring system, employee education and strategic placement of waste bins. This effort dramatically reduced the amount of red bag waste generated.
- Current estimates suggest that the hospital has saved well over $ 600,000 per year on medical waste costs and over $900,000 on all waste.
- Waste segregation programs like the BI's demonstrate that hospitals can reduce waste cost and remain in regulatory compliance.

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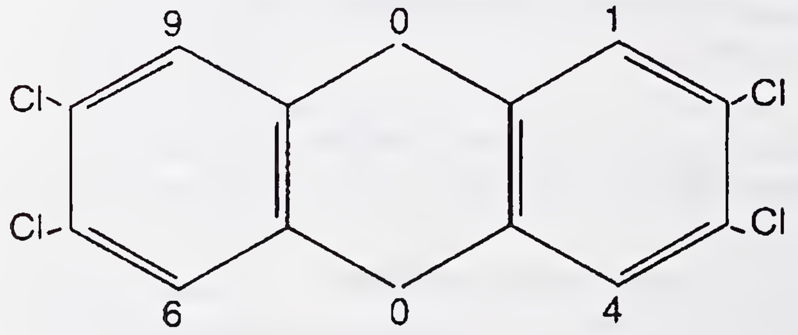
Dioxin: Where Does It Come From & What Are Its Effects

- Dioxin is a byproduct of incinerated waste, including medical waste, as well as certain chemical processes and paper manufacturing methods.
- A single very small dose (less than one-millionth of a gram per kilogram of body weight) on day 15 of pregnancy in the rat causes decreased sperm count, delayed testicular descent, and feminized sexual behavior in male offspring.
  - Mably et al., 1992 Toxicology and Applied Pharmacology Vol 114: 97-126
- Dioxin is a potent toxin at very low-levels of exposure, and is persistent in the environment.
- Approximately 7 year half-life in humans.

Diagram of Dioxin Molecule

Diagram of 2,3,7,8-TCDD



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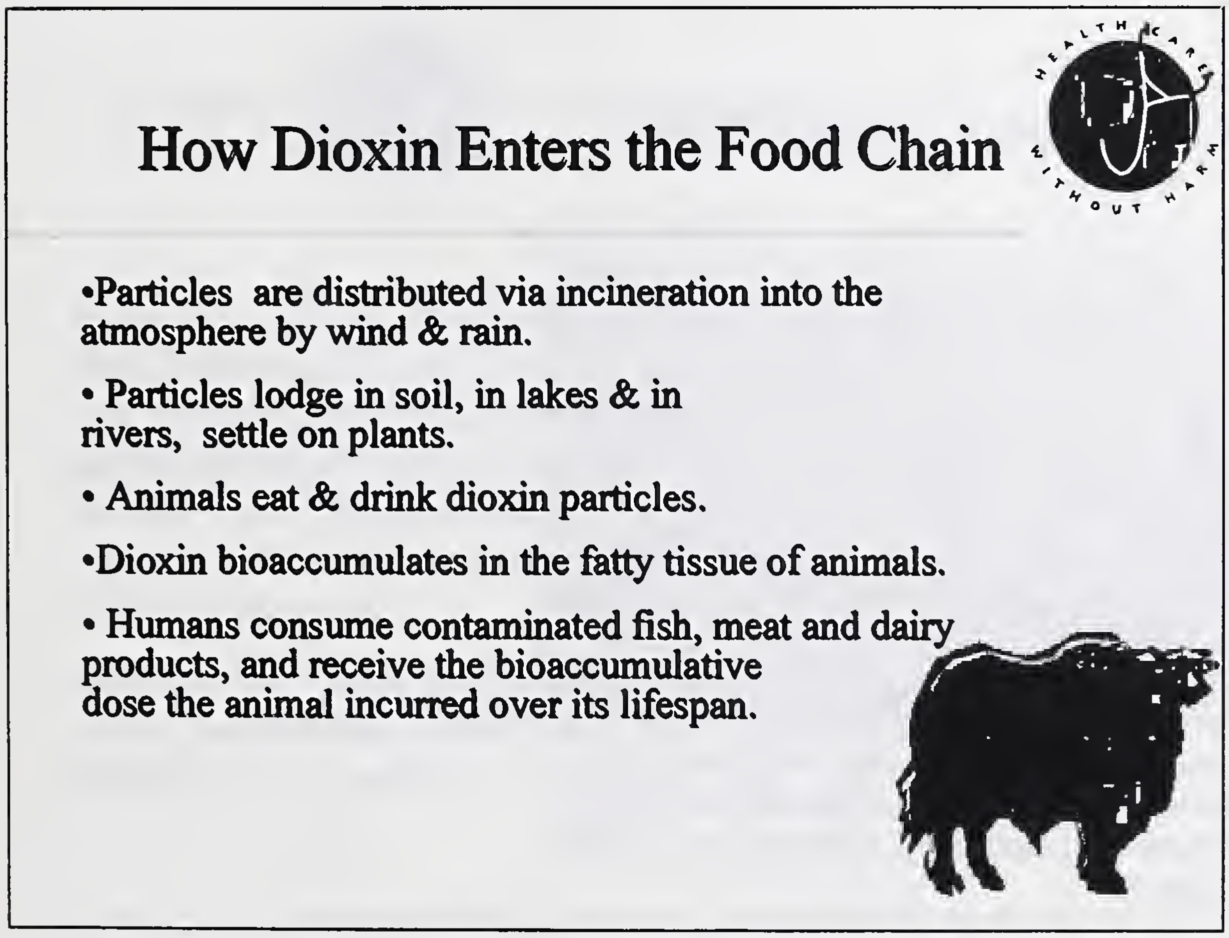
Dioxin As A Carcinogen In Humans

The U.S. EPA and the International Agency for Research on Cancer (IARC) have determined that exposure to dioxin causes cancer in humans.



How Dioxin Enters the Food Chain

- Particles are distributed via incineration into the atmosphere by wind & rain.
- Particles lodge in soil, in lakes & in rivers, settle on plants.
- Animals eat & drink dioxin particles.
- Dioxin bioaccumulates in the fatty tissue of animals.
- Humans consume contaminated fish, meat and dairy products, and receive the bioaccumulative dose the animal incurred over its lifespan.

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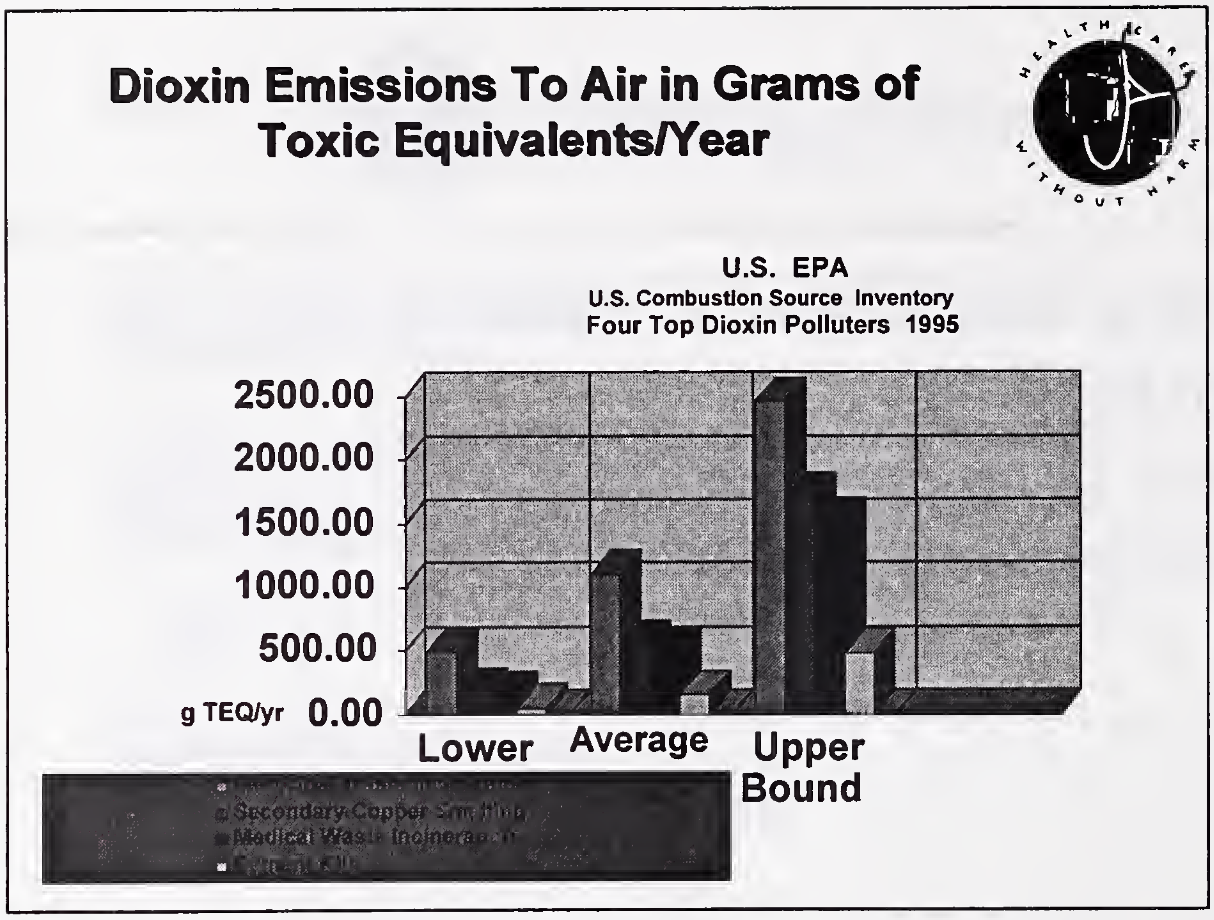
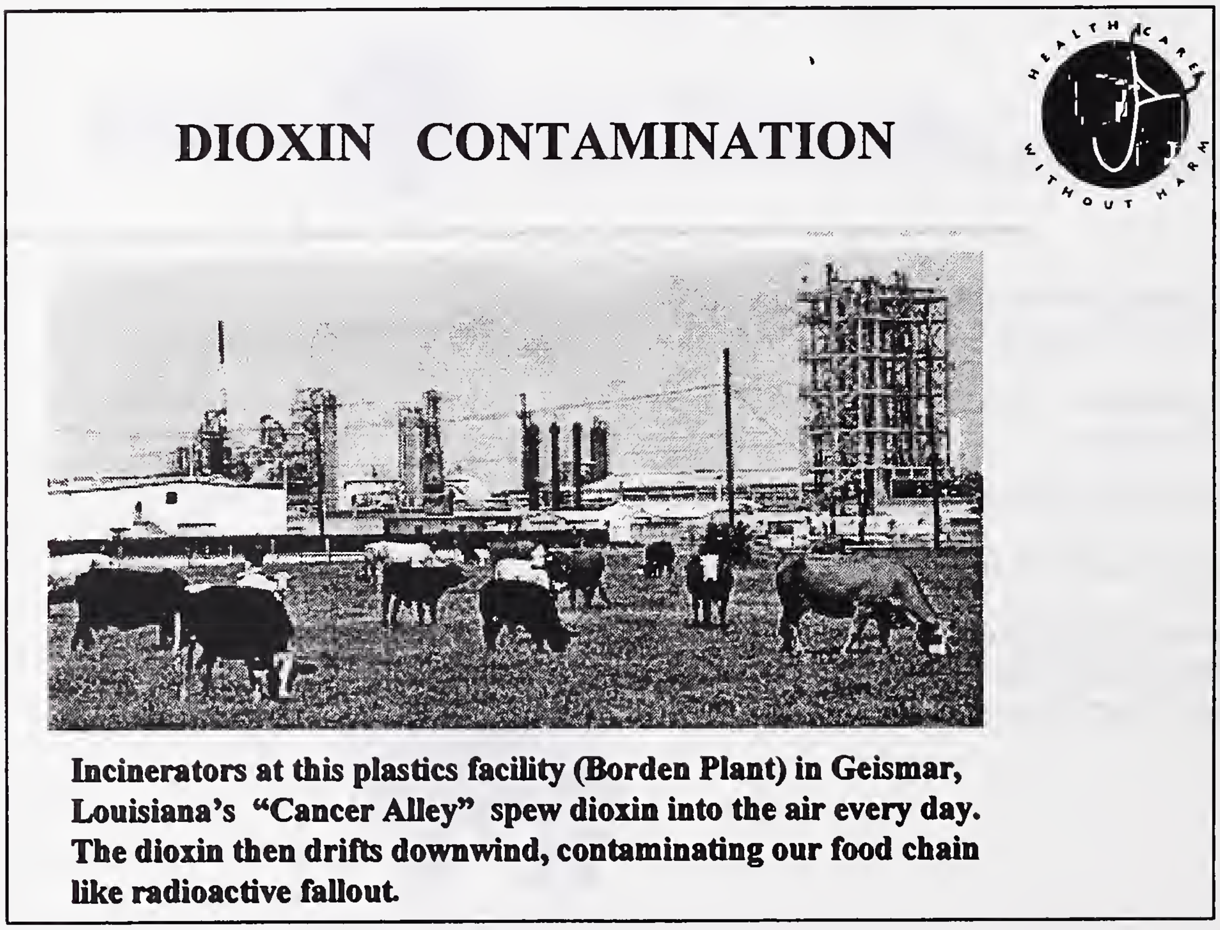


Dioxin Emissions To Air in Grams of Toxic Equivalents/Year

U.S. EPA
U.S. Combustion Source Inventory
Four Top Dioxin Polluters 1995



DIOXIN CONTAMINATION

Incinerators at this plastics facility (Borden Plant) in Geismar, Louisiana's "Cancer Alley" spew dioxin into the air every day. The dioxin then drifts downwind, contaminating our food chain like radioactive fallout.

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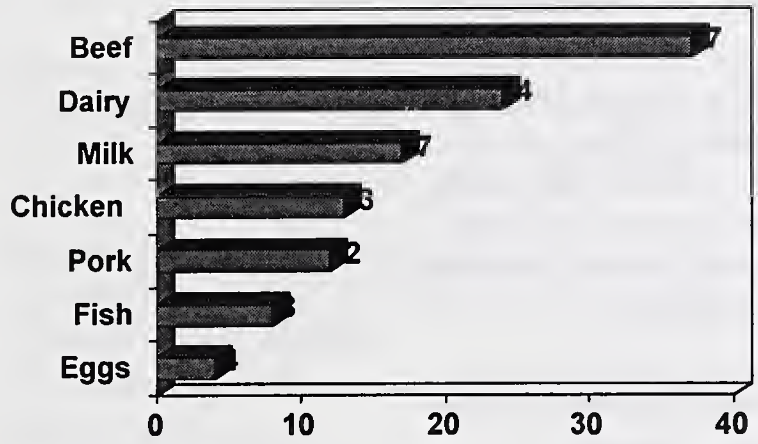
Daily Intake (pg) of Dioxin in Toxic Equivalents



Source: USEPA, 1994d

U. S. Environmental Protection Agency

In the U.S. EPA's 1994 Dioxin Reassessment, it estimates that the average levels of dioxin in all Americans is "at or approaching levels" where we can expect to see a variety of health effects. The EPA also estimates that adults consume 300-600 times the daily "safe" dioxin intake levels set by the Agency, while children consume 50 times more than the "safe" adult levels.

In short, Americans have reached maximum thresholds of dioxin, making it a public health necessity to stop dioxin pollution at its sources.

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World Health Organization (WHO) Re-Evaluates Health Risks From Dioxin

"In 1990 WHO experts established a TDI (tolerable daily intake) of 10 picograms/kilogram body weight for dioxin -TCDD. (One picogram equals a millionth of a millionth of a gram).

Since then new epidemiological data has emerged, notably concerning dioxins' effects on neurological development & the endocrine system... After ample debate the specialists agreed on a new tolerable daily intake range 1 to 4 picograms/kilograms body weight. The experts, however, recognize that subtle effects may already occur in the general population in developed countries at current background levels of 2 to 6 picogrames/kilogram body weight.

They therefore recommended that every effort should be made to reduce exposure to the lowest possible level. "

WHO Press Release/45 June 1998

Dioxin Equivalents Consumed Each Day at Different Ages

Age	pg/kg/day
Breast-fed infant	34-53
Formula-fed infant	0.07-0.16
1-4	1-32
5-9	1-27
10-14	0.7-16
15-19	0.4-11
Adult>20	0.3-3

Source: Schecter, 1994c

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Human Health Effects of Dioxin

Cancer

- Increased cancer mortality overall

Neonatal Abnormalities

- Change in sex ratio
- Altered level of thyroid hormone

Skin Disorders

- Porphyria cutanea tarda
- Chloracne

Immune System

- Change in immune system parameters / modulation

Endocrine System Effects

- Low levels of testosterone
- Increase glucose intolerance or diabetes
- Decreased estrogen & estrogen-receptor levels after fetal exposure

Health Effects of Dioxin in Animal Studies

Cancer

- Multiple sites

Fetal Abnormalities

- Cleft Palate
- Hydronephrosis
- Abnormalities in the reproductive organs
- Neurological problems
- Developmental delays

Reproductive Toxicity

- Decreased testis size
- Feminization of behaviors
- Adverse pregnancy outcomes
- Ovarian dysfunction

Endocrine System Alterations

- Altered glucose intolerance
- Altered fat metabolism
- Changes in thyroid hormone
- Decreased estrogen & estrogen-receptor levels after fetal exposure

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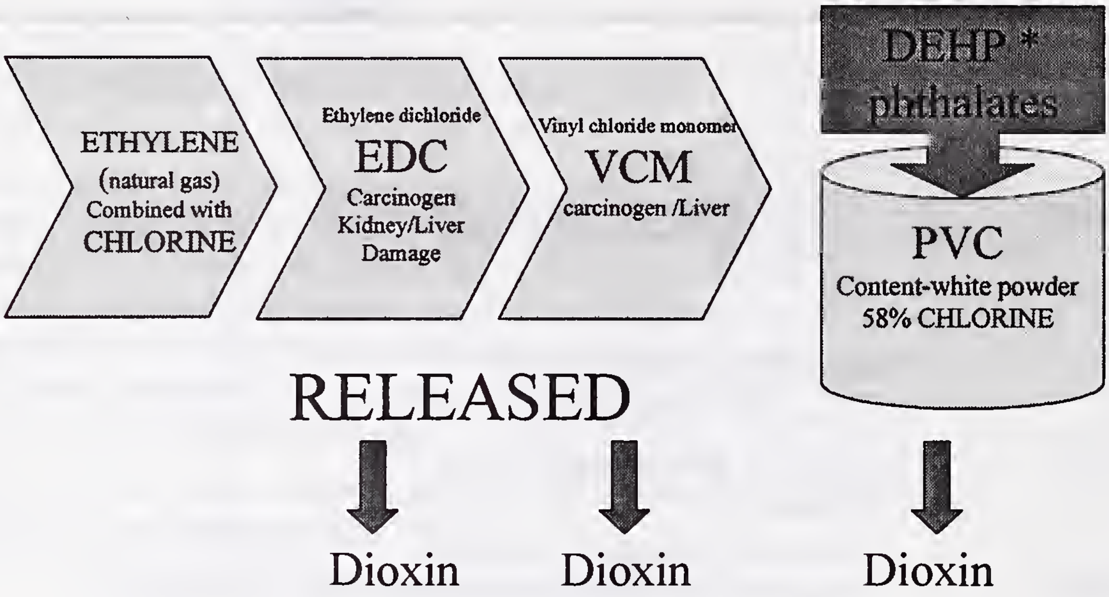
The PVC Life Cycle



ETHYLENE (natural gas) Combined with CHLORINE

Ethylene dichloride EDC Carcinogen Kidney/Liver Damage

Vinyl chloride monomer VCM carcinogen /Liver

DEHP * phthalates

PVC Content-white powder 58% CHLORINE

RELEASED

Dioxin Dioxin Dioxin

* Di-2-ethylhexyl phthalate (DEHP) is used to make PVC flexible

The PVC Life Cycle
(continued)

- The lifecycle hazards of PVC include:
  - 1. Releases of toxic byproducts of production (e.g., dioxin).
  - 2. The release of toxic additives during use (e.g., phthalates, heavy metals).
  - 3. Creation of dioxin when PVC is burned (e.g., in incineration or accidental fires).
  - 4. Contamination of recycling process.

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Polyvinylchloride Plastic

PVC is the Major Chlorine Donor for Dioxin Formation in M W I

- Dioxin generation depends on:
  - Waste stream composition (you need chlorine to make dioxin).
  - Incinerator design & operating conditions.

A majority of laboratory & full-scale incineration studies demonstrates a positive association between chlorine (PVC) inputs and dioxin emissions from incinerators. The industry's study (Rigo Report) is contrary to the preponderance of studies in the literature.

PVC is the Major Chlorine Donor for Dioxin Formation in MW I

- "...we are convinced that, when all other factors are held constant, there is a direct correlation between input PVC and output PCDD/PCDF and that it is purposeful to reduce chlorinated plastics inputs to incinerators."

John C. Wagner & Alex E.S. Green, "Correlation of Chlorinated Organic Compound Emissions from Incineration With Chlorinated Organic Inputs," Chemosphere, Vol. 26, No. 11, pp 2039-2054, 1993.

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Vinyl Institute's Study of Incineration and Dioxin Production

- The Rigo Report--commissioned by the Vinyl Institute & Environment Canada--flawed analysis & conclusions.
  - Used data collected for other purposes
  - Did not measure all dioxin produced
  - Measured dioxin at different points in exhaust stream
  - Failed to correct for other variables
  - Did find a relationship but reported it "not statistically significant"

Growth in PVC Sales*

North America

1965	2 billion pounds
1975	4 billion pounds
1985	8 billion pounds
1995	12 billion pounds

* Domestic & Export Sales

Source: The Geon Company

- 25% of all health care products contain PVC

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PVC in Medical Products

- IV bags
- Blood bags
- IV and respiratory therapy tubing
- Venodyne sleeves
- Patient ID cards
- Water bed liners
- Rigid packaging trays
- Mattress covers
- X-Ray folder holders
- Shower curtains
- Dialysis bags
- Thermal blankets

What Health Care Organizations Can Do To Phase Out PVC

- Work with purchasing and procurement to identify viable product substitutes
  - Examples of product substitutions:
    - Non-pvc IV Bags (e.g.,McGaw Bags)
    - Non-pvc blood bags (in R & D)
    - Non-pvc tubing
    - Non-pvc ID bands
    - Non-pvc suction liners
    - Non-pvc Sharps containers (reusable polyethylene containers)
    - Nitrile gloves rather than Vinyl gloves

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The Truth About PVC Recycling

Health Care Without Harm Campaign does not support PVC Recycling

- Consumer PVC products show the lowest recycling rates of any plastic. U.S. EPA estimates that less than 0.05% of the estimated 1.5 million tons of PVC in municipal solid waste was recycled (1995). According to the American Plastics Council, the total PVC recycling rate was 0.7% in 1995 and 0.9% in 1996.

- The Association of Postconsumer Plastics Recyclers, a recycling industry trade group, announced (April '98) that "efforts to establish long-term, economically viable markets for post-consumer PVC bottles, with the assistance of the Vinyl Institute, have proven unsuccessful.... PVC bottles are a contaminant to the recycling of PET and HDPE bottles."

The Truth About PVC Recycling

Health Care Without Harm Campaign does not support PVC Recycling (continued)

- PVC recycling is 2-3 times more expensive than the production of virgin PVC.

- PVC is unique in its high content of toxic additives (e.g. lead, cadmium, phthalates), needed to achieve the wide spectrum of PVC product applications.

- According to investigators who have inspected plastics recycling facilities in Asia, where most plastic is exported from the US, at least 1/3 of what is brought into most of the Asians countries is not recycled (it's getting burned or landfilled), while most of the rest is recycled into cheap low-quality goods.

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Phthalate Ester Plasticizers

- Danish EPA stated that, "phthalates are the most abundant man-made environmental pollutants, & human intake per day, via various routes, is measured in tens of milligrams." 1995
- Phthalates do not bond to PVC and leach readily.
- Dispersed into the environment mainly by becoming volatized & transported in the air. Global distribution, found in soil, air, water, sediments, animals and people. DEHP has been detected in pristine areas of the earth, such as Antarctica & in the center of the Pacific Ocean.

How Much Is Safe
vs
How Much We Get

- Total (Tolerable) Daily Intake (TDI)
  - European Economic Commission Scientific Committee on Food for DEHP is 0.2 milligrams daily for the average person.
  - TDI accepted under California's Proposition 65 Standard is 0.0 8 milligrams daily for the average person.
  - Estimated that the TDI from all sources of DEHP in the US is 5.8 milligrams per person per day (US Dept. of Health & Human Services, 1985)

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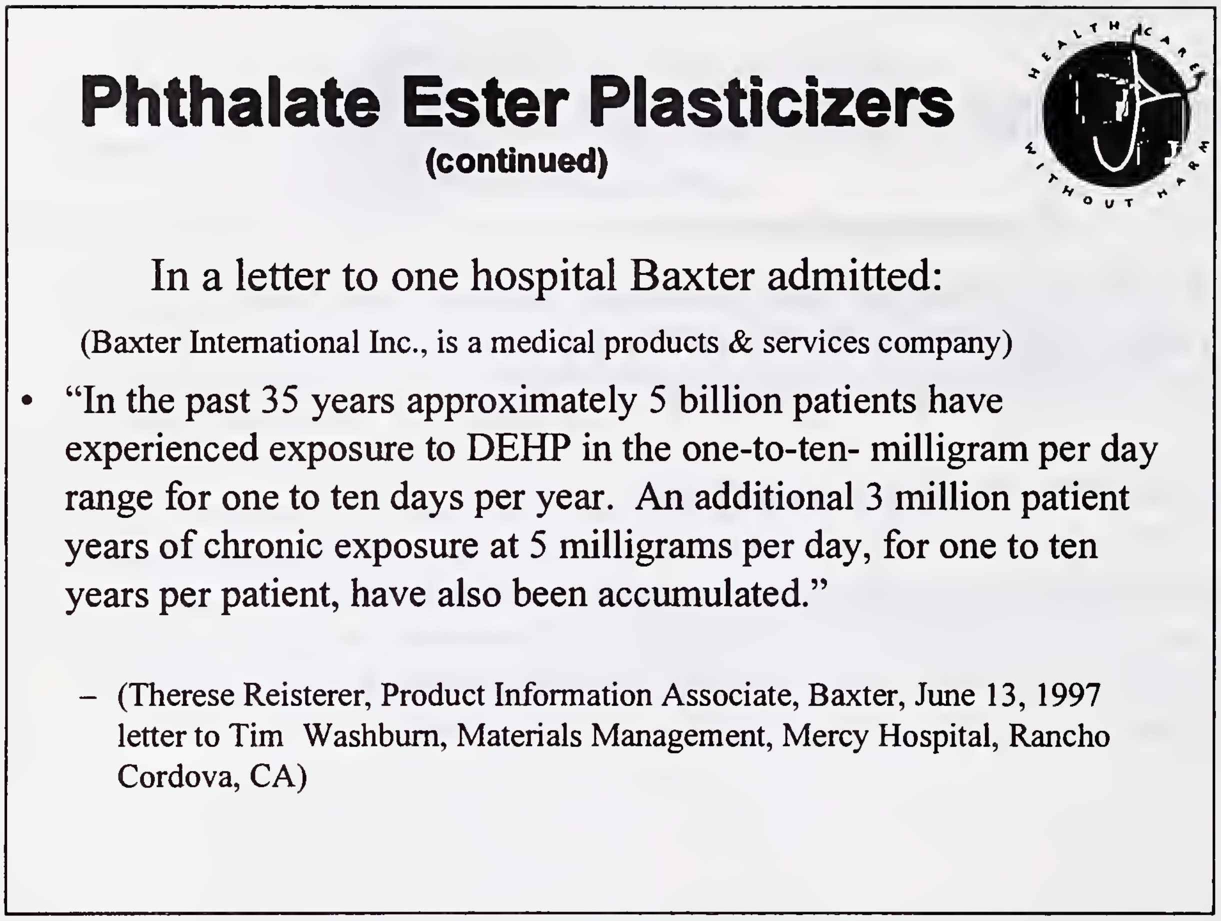
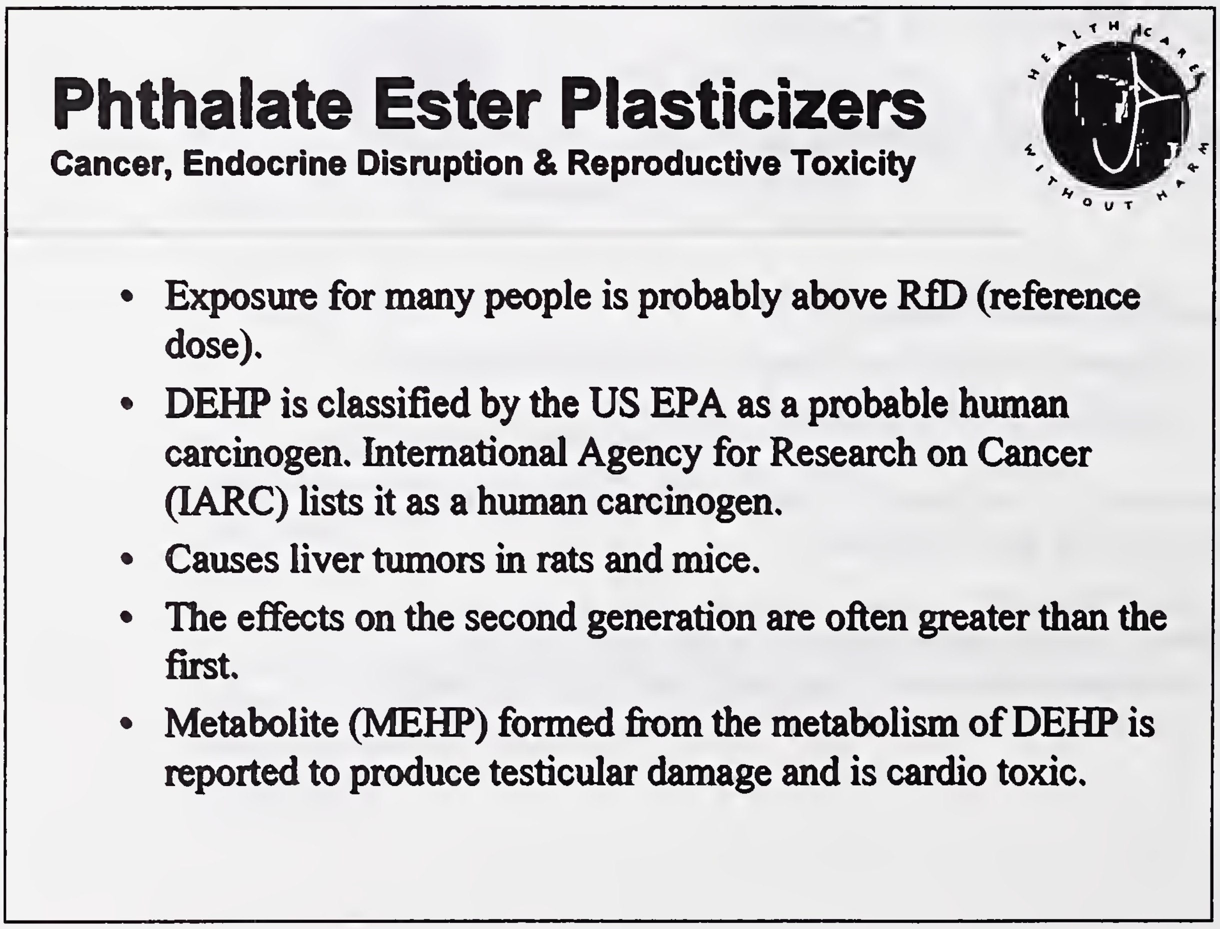


Phthalate Ester Plasticizers
(continued)

In a letter to one hospital Baxter admitted:

(Baxter International Inc., is a medical products & services company)

- "In the past 35 years approximately 5 billion patients have experienced exposure to DEHP in the one-to-ten- milligram per day range for one to ten days per year. An additional 3 million patient years of chronic exposure at 5 milligrams per day, for one to ten years per patient, have also been accumulated."
  - (Therese Reisterer, Product Information Associate, Baxter, June 13, 1997 letter to Tim Washburn, Materials Management, Mercy Hospital, Rancho Cordova, CA)



Phthalate Ester Plasticizers
Cancer, Endocrine Disruption & Reproductive Toxicity

- Exposure for many people is probably above RfD (reference dose).
- DEHP is classified by the US EPA as a probable human carcinogen. International Agency for Research on Cancer (IARC) lists it as a human carcinogen.
- Causes liver tumors in rats and mice.
- The effects on the second generation are often greater than the first.
- Metabolite (MEHP) formed from the metabolism of DEHP is reported to produce testicular damage and is cardio toxic.

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PVC Plasticizers & Endocrine Disruption

Emerging concerns about the phthalates esters is their ability to disrupt the endocrine or hormone system.

Several scientific studies have demonstrated that some phthalates, including butylbenzyl phthalate (BBP), dibutyl phthalate and diisononyl phthalate (DINP), are capable of binding to the estrogen receptor in human cell lines and of weakly mimicking the action of estrogen.

Phthalate Ester Plasticizers

(continued)

- Human exposure also occurs during medical treatment using equipment with DEHP-laced PVC plastic (IV bags, blood bags, tubing).
- Pregnant women, dialysis patients, and children may be at particular risk from DEHP exposure during medical treatment.

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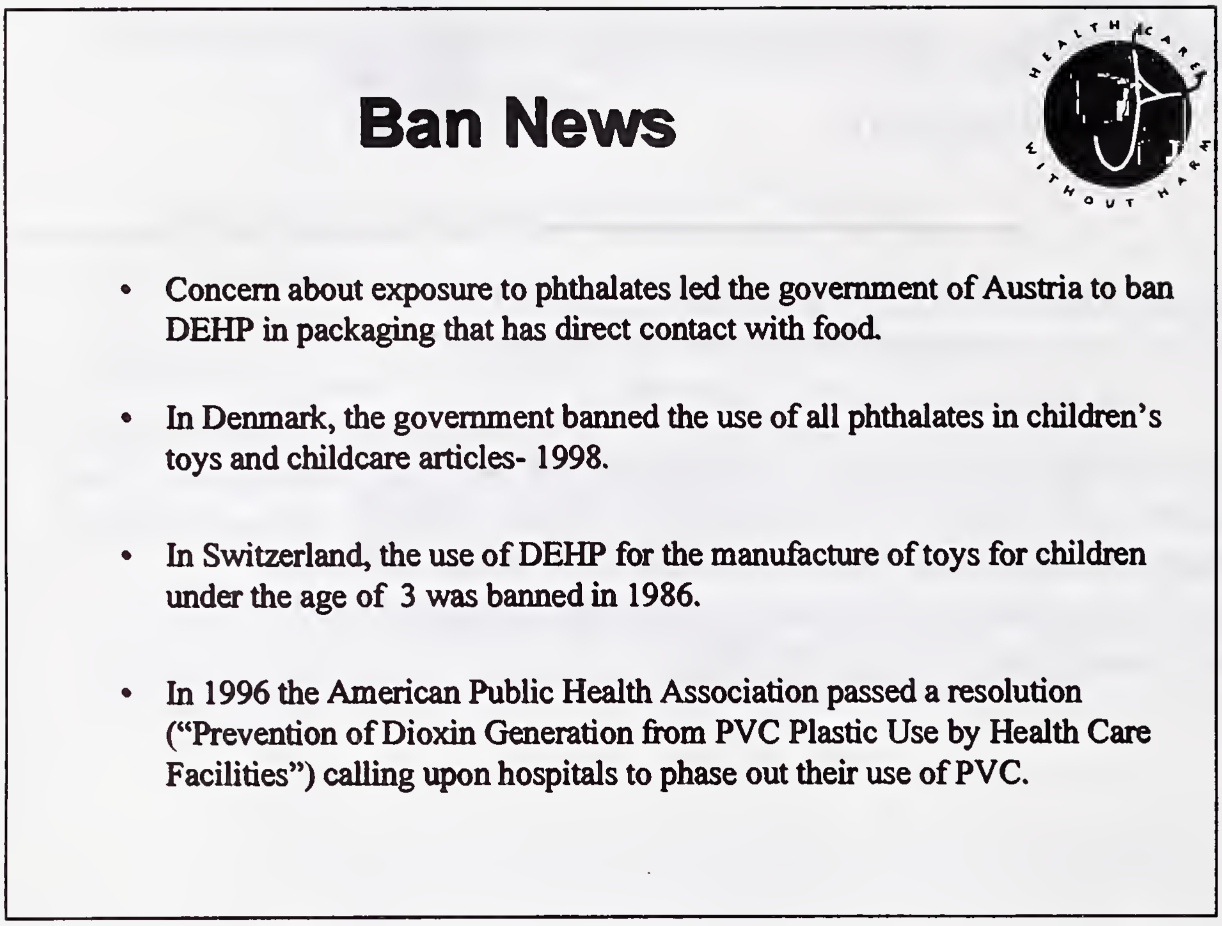
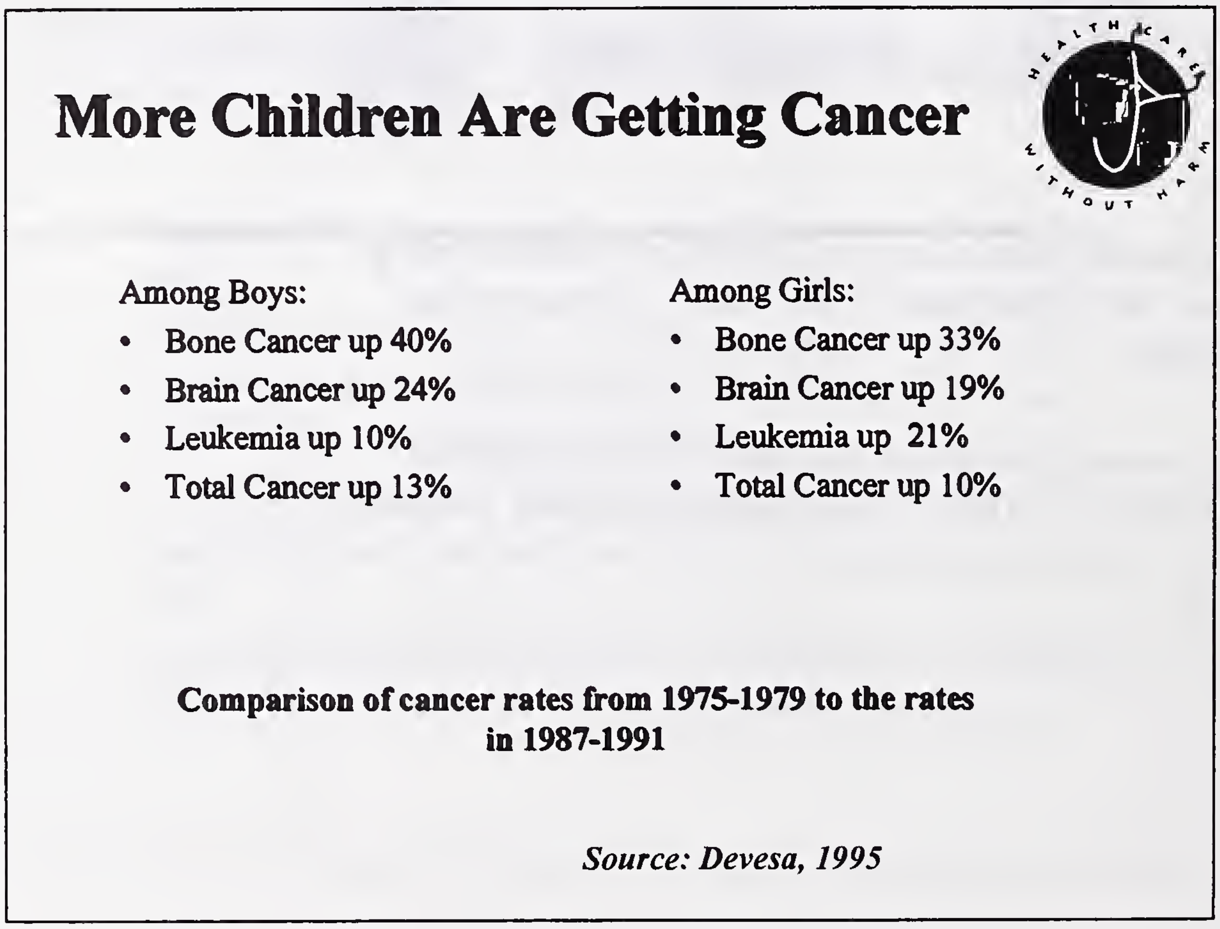


Ban News

- Concern about exposure to phthalates led the government of Austria to ban DEHP in packaging that has direct contact with food.
- In Denmark, the government banned the use of all phthalates in children's toys and childcare articles- 1998.
- In Switzerland, the use of DEHP for the manufacture of toys for children under the age of 3 was banned in 1986.
- In 1996 the American Public Health Association passed a resolution ("Prevention of Dioxin Generation from PVC Plastic Use by Health Care Facilities") calling upon hospitals to phase out their use of PVC.



More Children Are Getting Cancer

Among Boys:	Among Girls:
Bone Cancer up 40%	Bone Cancer up 33%
Brain Cancer up 24%	Brain Cancer up 19%
Leukemia up 10%	Leukemia up 21%
Total Cancer up 13%	Total Cancer up 10%

Comparison of cancer rates from 1975-1979 to the rates in 1987-1991

Source: Devesa, 1995

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More Children Are Getting Cancer (continued)

- "The increases [in the incidence of childhood cancer] are too rapid to reflect genetic changes, and better diagnostic detection is not a likely explanation. The strong probability exists that environmental factors are playing a role."

Dr. Philip J. Landrigan, a pediatrician who directs the division of environmental medicine at the Mount Sinai School of Medicine. Dr Landrigan is also senior advisor to the new office of children's health at the U.S. EPA.

More People in the United States Have Reproductive Health Problems

- In some areas of the U.S. and the world men have about half the sperm count of their fathers. Sperm counts in men 27-38 years old, declined by 50% over the 20-year period 1973-1993.
  Shanna Swan et al, Environmental Health Perspectives 1997.
- Hysterectomies have increased 250% for women under the age of 44 with endometriosis. Five and one-half million women in the North America are effected by endometriosis. Research by the Endometriosis Association (EA) revealed a startling link between dioxin exposure & the development of endometriosis. EA discovered a colony of rhesus monkeys that had developed endometriosis after exposure to dioxin.

Note: {In utero & lactational exposure of the male rat to dioxin (2,3,7,8-TCDD) impairs prostrate development. {Roman et al, Toxicology & Applied Pharmacology 1998}

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Some Birth Defects Are Increasing

- According to a study by the Birth Defects Monitoring Program, more than 30 types of birth defects increased steadily during the 7-year period from 1979-80 to 1986-87. Heart defects increased the most.
- A quarter of a million U.S. babies are born with birth defects every year, according to a study conducted by the U.S. General Accounting Office.
- Incidence of undescended testes (cryptorchidism) has doubled since 1960.
  Giwercman et al, Environmental Health Perspectives 1993
- Hypospadias, a birth defect in which the urinary canal opens on the underside of the penis, has also increased 100% since 1960.
  L. Paulozzi: Center for Disease Control & Prevention 1997

Nobody's Exempt: The Role of Administrators in Controlling Waste

Kaiser Permanente * Mission Statement

- "Our mission is to improve the health of the communities we serve. Our resource conservation initiative is closely aligned with this mission because the health of the environment is an important factor in the health of the communities. We think of environmental protection as preventive medicine on a grand scale."

David Lawrence, MD, Chairman & CEO of Kaiser Permanente

*Over 9 million members in 19 states with 15,000 physicians.

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Kaiser Permanente's Resource Conservation Initiative

- Purpose:
  - Ensure that all of KP's business activities are aligned with protecting the environment

Goals:

- Minimize waste
- Prevent pollution
- Conserve natural resources
- Reduce costs
- Model environmental protection practices

Health Care Without Harm Report

"Greening" Hospitals

An Analysis of Pollution Prevention in America's Top Hospitals

According to the report medical waste incinerators are among the top man-made sources of both mercury and dioxin emissions into the environment having wide public health impacts outside of the institution.

Gary Cohen
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“Greening” Hospitals

- This study draws on survey results obtained from 50 of the nation’s top hospitals, derived from the list of the top 135 hospitals in the nation compiled by *U.S. News & World Report*.
- A first of its kind environmental survey uncovered widespread failure on the part of medical facilities to take steps to halt contamination of milk, meat, and fish by dioxin and mercury.
- Incineration of 2 million tons of hospital waste each year constitutes a major source of both of these pollutants (dioxin and mercury).

“Greening” Hospitals
Major Findings

- Of the hospitals that have mercury reduction programs, 37% of the hospitals still buy patient thermometers that contain mercury and nearly half buy mercury blood pressure devices.
- Over 40% of survey respondents continue to incinerate medical waste that should be treated by safer methods.
- Only 2% of hospital waste needs to be incinerated to protect the public health, yet some hospitals incinerate 75% - 100%.
- The average hospital is only recycling approximately one-third of the readily recyclable items. The most number of items recycled was 31; some hospitals recycle none.

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“Greening” Hospitals

Major Findings

(continued)

- Almost 60% of the respondents report buying reusable goods over disposables where feasible, and 46% have packaging reduction programs in-place.

- 62% of the hospitals require vendors to disclose the presence of mercury in chemicals that the hospitals purchase and only 12% of the hospitals distribute mercury-containing thermometers to new parents.

Health Care Without Harm

“Greening” Hospitals Report

“Greening” Hospitals Report
is on-line at our Web site:

www.noharm.org

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Practicing Dioxin and Mercury-Free Medicine

- Environmentally sound procurement policies
- Minimization of packaging
- Reusable instead of disposables
- Ongoing Red Bag Reduction Education
- Waste segregation
- Recycling
- Safe waste treatment choices (technologies)

Opportunities for Reuse in Health Care

- Built in eggcrate mattresses
- Reusable dishware and cutlery
- Reusable cloth underpads
- Reusable personal protection gowns
- Double sided copies
- Reusable inter-office mailers
- Reusable plastic or steel emesis and wash basins
- Reusable respiratory therapy equipment
- Rechargeable batteries
- Reusable packaging units -- tubs, totes, sharps containers

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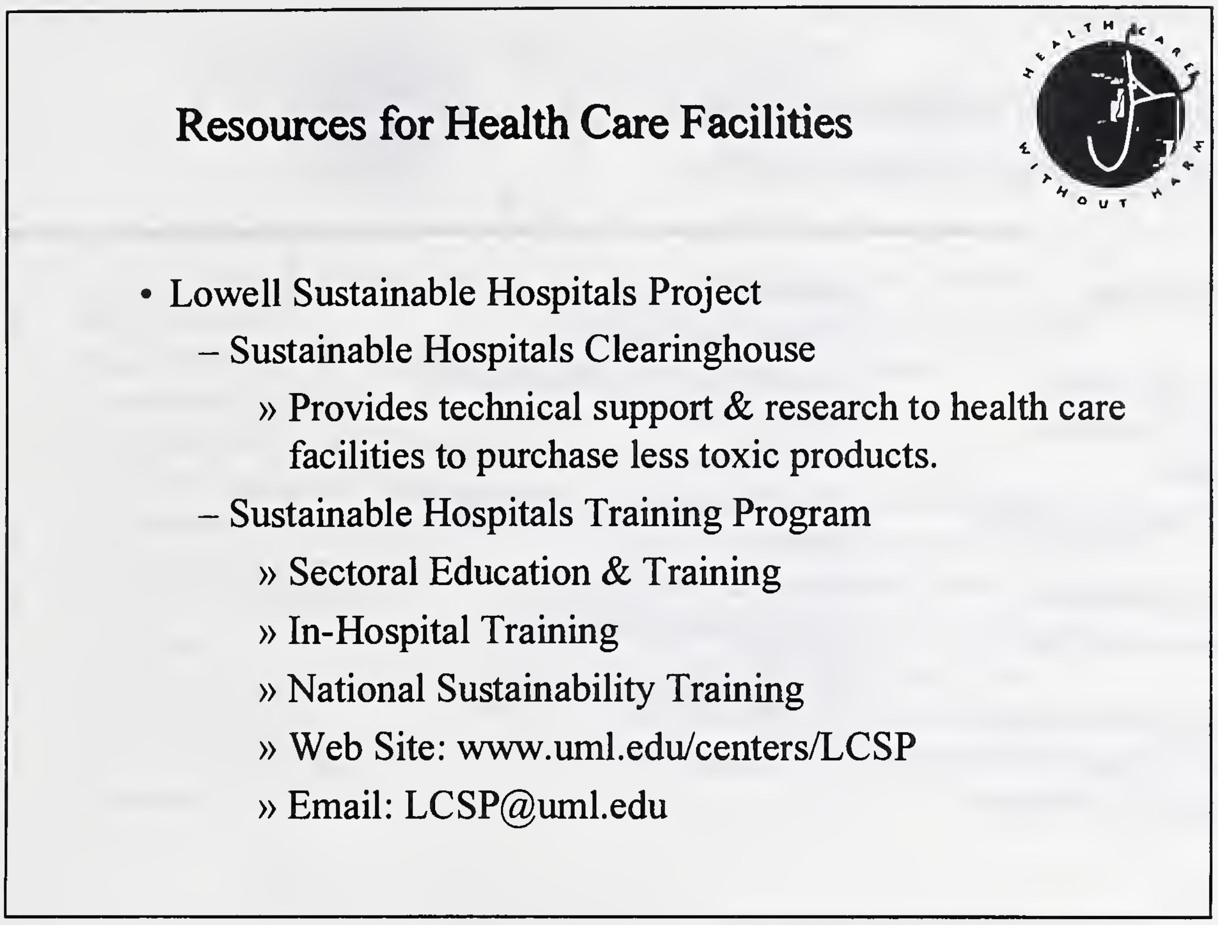
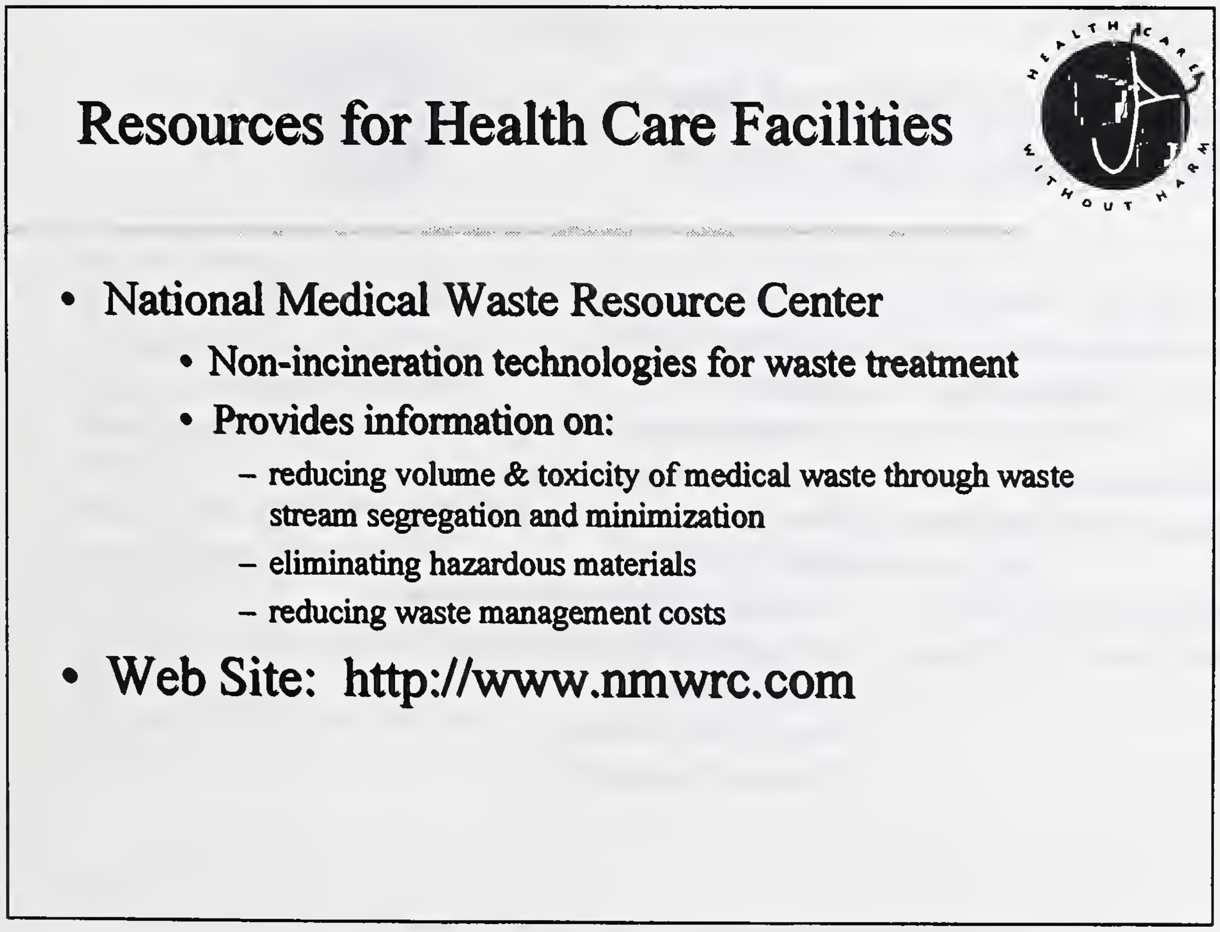


Resources for Health Care Facilities

- Lowell Sustainable Hospitals Project
  - Sustainable Hospitals Clearinghouse
    - » Provides technical support & research to health care facilities to purchase less toxic products.
  - Sustainable Hospitals Training Program
    - » Sectoral Education & Training
    - » In-Hospital Training
    - » National Sustainability Training
    - » Web Site: www.uml.edu/centers/LCSP
    - » Email: LCSP@uml.edu



Resources for Health Care Facilities

- National Medical Waste Resource Center
  - Non-incineration technologies for waste treatment
  - Provides information on:
    - reducing volume & toxicity of medical waste through waste stream segregation and minimization
    - eliminating hazardous materials
    - reducing waste management costs
- Web Site: http://www.nmwrc.com

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Health Care Without Harm
Participating Organizations

- Action for Women's Health
- AFL-CIO
- American Nurses Association
- Beth Israel Health Care System
- Breast Cancer Action
- Blue Ridge Environmental Defense League
- California Nurses Association
- California Communities Against Toxics
- California, Nevada Board of Church & Society, United Methodist Church
- Cambridge Women's Cancer Project
- Cathedral of Saint John the Divine
- Catholic Healthcare West
- Center for Health, Environment and Justice
- Center for Environmental Health
- Center for the Biology of Natural Systems
- Centre national d'information indépendante sur les déchets (CNIID)
- CGH Environmental Strategies

Health Care Without Harm
Participating Organizations

- Chemical Impact Project
- Citizens Environmental Coalition
- Citizens for a Better Environment
- Clean North
- Cleveland Earth Day Coalition
- Committee of Interns and Residents
- Commonweal
- Department of Environmental Health, Boston University School of Public Health
- DES Cancer Network
- Earth Day Coalition
- EarthSave
- Ecology Center of Ann Arbor
- Endometriosis Association
- Environmental Association for Great Lakes Education
- Environmental Stewardship Concepts
- Environmental Working Group
- Essential Action
- Farm-Verified Organic
- Fletcher Allen Health Care

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Health Care Without Harm
Participating Organizations

- Galveston-Houston Association for Smog Prevention
- General Board of Church & Society, United Methodist Church
- Government Purchasing Project
- Great Lakes Center for Occupational & Environmental Safety and Health
- Great Lakes Natural Resource Ctr. National Wildlife Federation
- Greenpeace
- Hamtramck Environmental Action Team (HEAT)
- Human Action Community Organization
- Indigenous Environmental Network
- Institute for Agriculture & Trade Policy
- Jenifer Altman Foundation
- Judith Helfand Productions
- Kirschenmann Family Farms
- Learning Disabilities Association
- Legal Environmental Assistance Foundation
- Lone Star Chapter of the Sierra Club
- Massachusetts Breast Cancer Coalition
- Massachusetts Nurses Association
- Mid-Michigan Environmental Action Council
- MN Center for Environmental Advocacy

Health Care Without Harm
Participating Organizations

- Mt. Sinai School of Medicine
- Multinationals Resource Center
- Mumbai Medwaste Action Group
- National Environmental Law Center
- Natural Resources Defense Council (NRDC)
- National Women's Health Network
- North Carolina Breast Cancer Coalition
- NC Waste Awareness & Reduction Network.
- National Medical Waste Resource Center
- New England Medical Center
- New York State Nurses Association
- North Carolina Breast Cancer Coalition
- Ohio Network for the Chemically Injured
- Oil, Chemical and Atomic Workers Union
- Oncology Nursing Society
- Oregon Center for Environmental Health
- Physicians for Social Responsibility
- Pollution Probe
- Reduce Recidivism by Industrial Development, Inc..

Gary Cohen
Health Care Without Harm
Jamaica Plain, Massachusetts

Health Care Without Harm

Participating Organizations

- Reconstructionist Rabbinical Association
- Save Our County
- Science & Environmental Health Network
- Sierra Club
- South Bronx Clean Air Coalition
- South Carolina State Nurses Association
- Srishti
- The Breast Cancer Fund
- Toxics Action Center
- United Citizens and Neighbors
- 1199
- Vermont Public Interest Research Group
- Vietnam Veterans of America - Michigan Chapter
- Washington Toxics Coalition
- WEDO
- White Lung Association
- Women's Cancer Resource Center -- Berkeley, CA
- Women's Cancer Resource Center -- Minneapolis, MN
- Women's Community Cancer Project
- Work on Waste

***Gary Cohen** is one of the principal founders of Health Care Without Harm, and has directed the organization since it's inception. Health Care Without Harm is a public interest coalition concerned about the environmental practices of the health care industry. He can be contacted at 41 Oakview Terrace, Jamaica Plain, Massachusetts 02140. Phone: (617) 524-6018. Fax: (617) 524-7021. E-mail: gcohen@igc.apc.org.*

Section 2: General Medical Facilities

Robert K. Gingras, P.E., DEE
Earth Tech, Inc.
Concord, Massachusetts

A Case Study: Mercury Reduction Efforts in a Clinical Laboratory

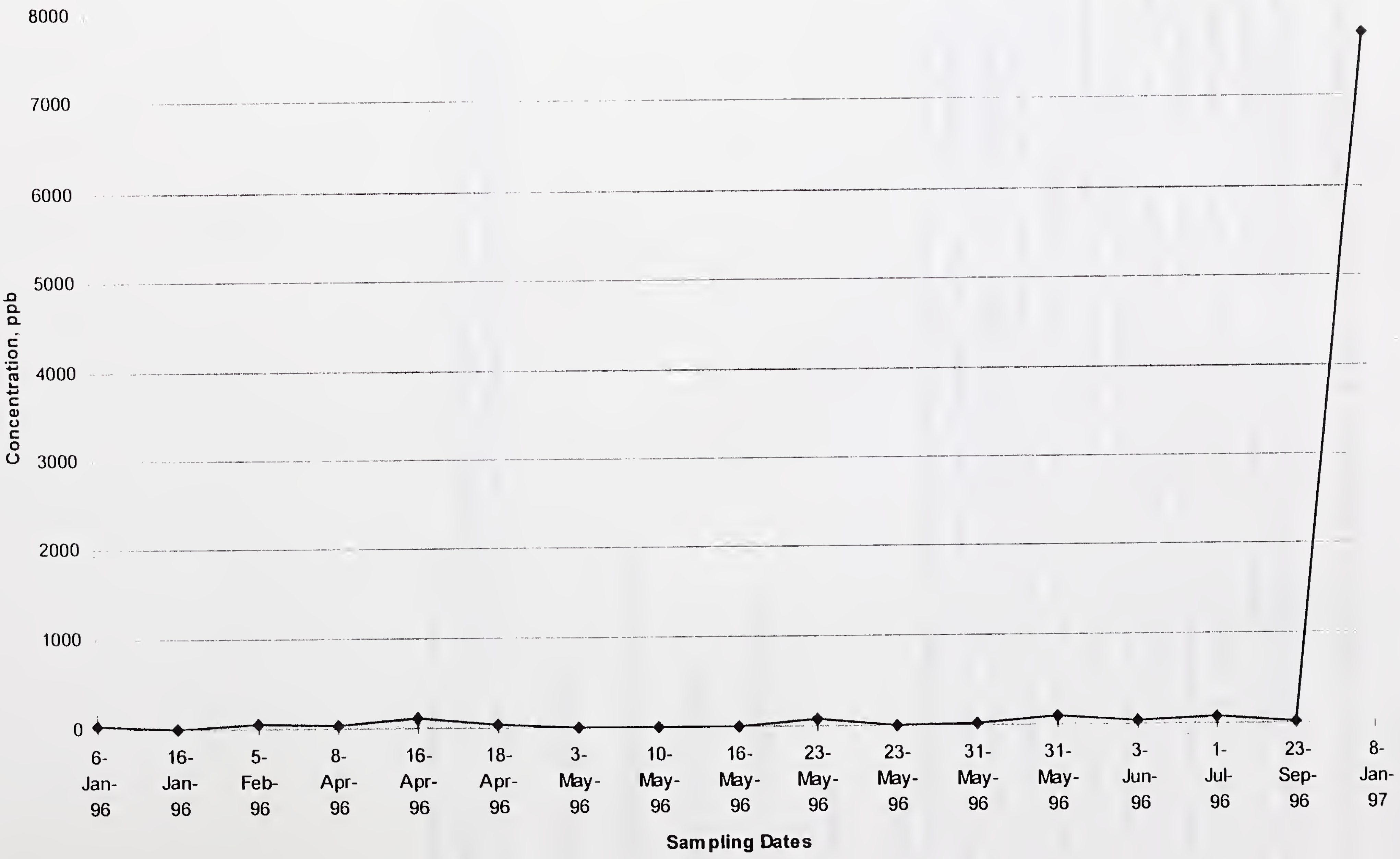
One of the oldest major Metropolitan Boston teaching Hospitals was having difficulty achieving the MWRA's mercury enforcement limit of 1 ppb in the effluent discharged from its Clinical Laboratory. Initially, extensive analysis of reagents was completed to help identify possible sources of mercury that had previously been unrecognized as entering the facility infrastructure. Training of laboratory personnel in the use of product substitutes (*mercury free reagents*) or the use of alternative mercury management techniques and the isolation of selective workstations from the facility infrastructure was completed but failed to correct the problem. Subsequent infrastructure investigations revealed the presence of contaminated piping which, once removed, helped the facility to achieve compliance with the enforcement standard. Details of the work performed, chemistries analyzed, timelines encountered and serial progress in reducing the mercury concentration of the effluent from parts per ***million*** to sub-parts per billion with be highlighted.

The Setting

- Major Teaching Hospital
- Merging Resources
- Escalated MWRA Enforcement
- Clinical Laboratory

blood gas and blood chemistry; chemistry; cytogenetics; hematology; immunology (including serology); microbiology (virology, mycology, bacteriology & parasitology); phlebotomy; radiology; urinalysis

Mercury Discharge Concentrations, 1996



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Earth Tech, Inc.
Concord, Massachusetts

The Problem

Effluent Mercury Discharge Concentration Peaks in January, 1997 at 7,700 ppb in 700 gpd Flow

⇒ Translates to 0.75 ounces

Was It Due to:

- A Broken Thermometer?
- A Mistaken Discharge of an Identified Mercury Bearing Reagent?
- A Legitimate Discharge of an, as yet, Unidentified Mercury Tainted Reagent?
- Something Else?

The Options

- Total Bulk Out
    - ⇒ Not feasible
    - ⇒ Not cost effective
    - ⇒ Not environmentally responsible
- End-of-Pipe
    - ⇒ Not proven
    - ⇒ Not cheap
    - ⇒ Not simple
    - ⇒ Not quick
- Localized Bulk Out*

Selected as a means of isolating the "unknown" source

The Impediments

- Multiple Level, Compound Structure
- Questionable Accuracy of "Record Drawings" due to Facility Age
- Inaccessible Piping
- Limited Floor Space
- Facility Age
- Limited Product Information
- Limited Staff Resources

Robert K. Gingras, P.E., DEE
Earth Tech, Inc.
Concord, Massachusetts

The Strategy

- Assemble the Team
    - ⇒ Facility Personnel
    - ⇒ Clinicians
    - ⇒ Administration
    - ⇒ External Support

The Process

- Verify "Special Waste" Risers
- Isolate & Redirect Non "Special Waste" Sources
- Reroute Sources to "Clean" Risers
- Replace "Accessible" Piping
- Install Collection Pails & Tanks
- Implement the Use of "Dump Logs"
- Cease All Discharge for 5 days (24 hpd)
- Collect & Analyze All Pail Contents
- Powerwash the Collection System
- Install Riser Isolation Valves
- Replace the IWWT System Tank
- Haul All Collected Wastewater

The Results

- 180 Samples Taken
    - ⇒ 22 Contained Detectable Mercury
    - ⇒ 12 Contained Mercury > 0.5 ppb
    - ⇒ 6 Contained Mercury > 1.0 ppb
- Of the Positive Hits, No Clear Trend
- "Normal" Operations Significantly and Adversely Affected
- Compliance Not Attained

Riser Wash Samples Provide a Clue

- "A" Riser - 0.5 ppb
- "C" Riser - 3.9 ppb < *suggests an undiscovered source*
- "D" Riser - 0.6 ppb

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The Decision

- Re-Trace all “Special Waste” Lines
- Replace all “Inaccessible” Piping

The Discovery

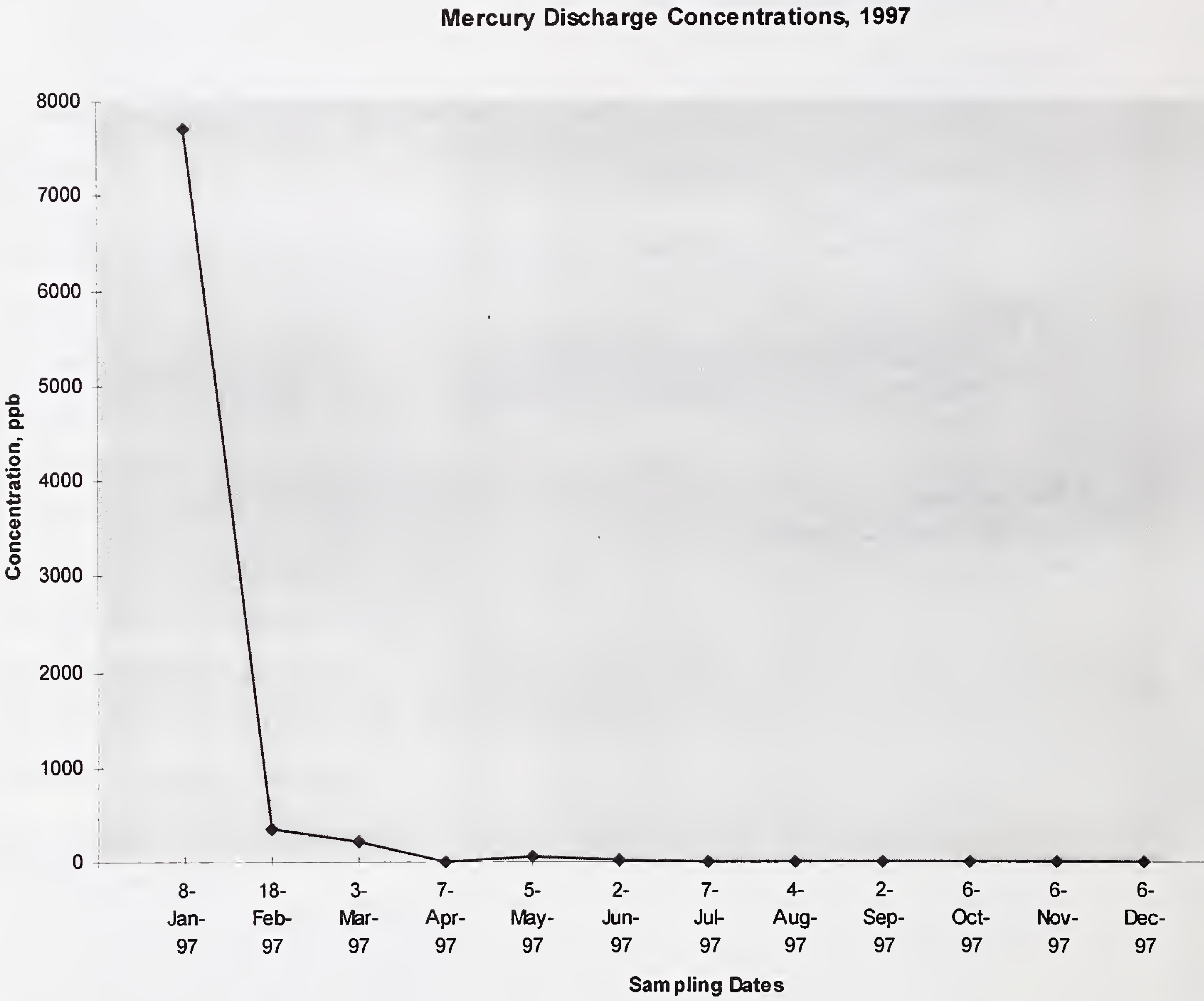
- 20 Foot Length of Ductile Iron (DI) & Polypropylene (PP) Piping Found Embedded Within a Wall
- Sections Extracted & Analyzed

⇒ Polypropylene Pipe
    Test Sample: 1,295,000 ppb
    Leachate: 4,773 ppb

⇒ Ductile Iron Pipe
    Test Sample (loose deposits): 196,000 ppb
    Scrapings from Inner Surface: 1,187,000 ppb
    Leachate: 47.5 ppb

The Solution

- Abandon Pipe, in place
- Repipe with PP


Mercury Discharge Concentrations, 1997
Concentration, ppb
8000
7000
6000
5000
4000
3000
2000
1000
0
8-Jan-97
18-Feb-97
3-Mar-97
7-Apr-97
5-May-97
2-Jun-97
7-Jul-97
4-Aug-97
2-Sep-97
6-Oct-97
6-Nov-97
6-Dec-97
Sampling Dates

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The Cost - $75,000

Including:
- Waste Disposal
- Tank Replacement
- Powerwashing
- Accessible Pipe Replacement
- Inaccessible Pipe Replacement
- Outside Support

Excluding:
- Staff Labor
- Sample Analyses

Some Lessons Learned
- Gram & Wright Stains
- Bouins & B-5 Fixatives
- Hand Soaps & Creams
- Unadulterated Urine & Blood Products
- Boraxo® Pads

Processes & Reagents Found to Contain Mercury

Autoanalyzers:		*Reagents:*	
Autodelfia	3.1 ppb	Trichrome Blue Stain	7.1 ppb
Iris	0.3 ppb	TB Decolorizer	65.6 ppb
Cotter	0.3 ppb	Formalin	25.8 ppb
Technicon H2	0.4 ppb	Bouins	46.6 ppb
Hitachi	0.3 ppb	B-5 Fixative	148.4 ppb
Chem-Array	0.4 ppb	Effect II	23.3 ppb
Chem-IMX-1	0.4 ppb	Aldex	99.9 ppb
Chem-IMX-2	0.4 ppb	RDO	24.6 ppb
Chem-654	0.4 ppb	Sponge Exudate	124.6 ppb
Chem-Autodelfia	0.8 ppb		
Chem-SEC 6	0.9 ppb		
HEME MDA	2.1 ppb		

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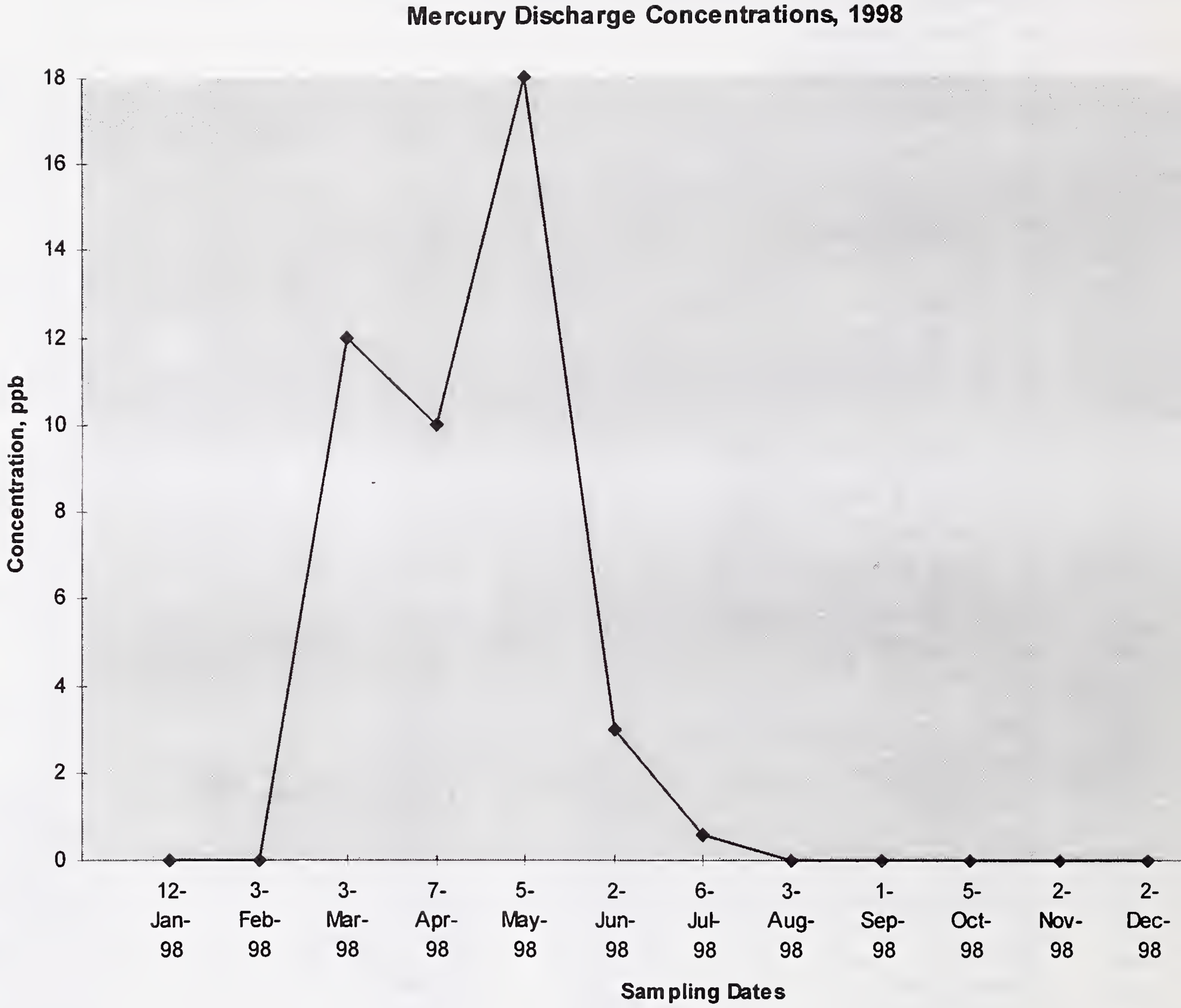
The End?



Bob Gingras is a Senior Program Director at ***Earth Tech*** *currently assigned to the Environmental Compliance and Engineering Group. During his more than 20 years in the practice of professional environmental engineering, he has designed and implemented pollution prevention/waste minimization and recycling systems for a variety of clients including those in the electronics, metal finishing, textile, health care, commercial laundering and printing industries. He can be contacted at Earth Tech, 196 Baker Avenue, Concord, Massachusetts 01742-2167. Phone: (978) 341-4000.*

Scott A. George
Recycling Coordinator
Cape Cod Healthcare Inc.

Getting Started - It Takes Little Time and Makes a BIG Difference !

1) Starting from Top to Bottom :
   CEO - PRESIDENTS - NURSE MANAGERS - DIRECTORS
   MATERIALS MANAGEMENT, ENVIRONMENTAL SERVICES -
   STAFF EDUCATION - ALL DEPARTMENT HEADS ;

   all of the above must be on board and ready to accept change in how waste is handled at your facility. Drafting a memo asking for their support and commitment is essential.

2) Contents of your Recycling Memo :
   A) State your purpose and your needs.
   B) Tell of mandatory recycling and landfill cappings State wide.
   C) Lay-out your strategy as to how recycling will effect your facility.

3) Form a Recycling Committee : Be sure to invite all levels of your staff to be on this committee. Meet once a month.

4) Goals and Strategies :
   A) Identify any ongoing programs.
   B) Document expenses and savings from those programs.
   C) Purchase a Recycling Bulletin Board
   D) Send out a newsletter to the general population explaining ongoing programs and ask for the staffs help.
   E) Identify obstacles and solve them.
   F) Draft a memo to be included with information packets that are handed out to new employees
   G) Create policy for ongoing and future recycling programs.
   H) At mandatory Staff meetings address recycling issues and ask the Staff for their participation.
   I) Create new recycling programs that are well thought out and cover all angles.

I have enclosed examples of memos that I have used at my Health Care Facility.
If you have any Questions feel free to contact me at:
Office: 1-508-771-1800 X 2472
Fax : 1-508-790-4657

Scott A. George
Recycling Coordinator
Cape Cod Healthcare Inc.

RECYCLING COMMITTEE PROGRESS REPORT

To: Operational Improvement Committee
From: Scott A. George; Recycling Coordinator
Re: Recycling Fiscal Impact - June , 1996 -

In February of 1995 the Recycling Committee was formed at the request of concerned employees via the Q.I. Committee. Since that time we have met monthly and continue to meet monthly. We have identified several recycling opportunities and several obstacles to those opportunities. In our meetings it is our goal to remove the obstacles and implement recycling programs whenever it is reasonable and possible.

The following is a list of recycling programs and their financial impact:

PROGRAM/PROJECT	ANNUAL SAVINGS/INCOME	STATUS
1) Mixed Paper	$4,716.00	Active
2) Cardboard	$14,184.00	Active
3) Sorting and Separating	$114,511.00	Active
4) Egg Crate Overlays	$40,000.00	Active
5) Xylene Reclaiming	$4,582.00	30 day Trial
6) Plastics	N/A	Researching
7) Mercury	N/A	Researching
8) Glass	N/A	Researching
9) Kitchen Waste	N/A	Researching
10) Batteries	N/A	Researching
11) Lighting	N/A	Researching
12) Hospital Equipment	N/A	Developing

TOTAL PROJECTED YEARLY SAVINGS......... $177,993.00

Scott A. George
Recycling Coordinator
Cape Cod Healthcare Inc.

**************************** A Look Into The Future ***********************

In the future we can see Recycling playing a huge part in our waste management at CAPE COD HEALTHCARE,Inc.. To find signs of what is to come we need only look as far as our own landfills. The State of Massachusetts mandates that most of Cape Cods landfills be capped. Presently we as residents need to separate our household trash before we bring it to our local landfills and in the future we might be asked to pay for all non-separated and non-recyclable household waste.

The next step that may be taken by the Commonwealth will be to mandate all large employers in the state (including all Hospitals, public and private schools, Gov. buildings and colleges) to recycle a certain percentage of their waste stream. Staying one step ahead will benefit C.C.H. in the near and distant future.

What we have started here at CAPE COD HOSPITAL can and should assist our other entities in our Healthcare system. The recognition that we are receiving for our recycling efforts will give us a step up in all aspects of the Healthcare industry as we strive to become leaders and set the example for others to follow.

****

Scott A. George
Recycling Coordinator
Cape Cod Healthcare Inc.

SAMPLE

To: New Employees
From: Recycling Coordinator
Re: Recycling at XYZ Medical Facility

In February of 1995 a Recycling Committee was formed at XYZ Medical Facility. The committee's mission is to identify obstacles, and to overcome them as they related to recycling and energy conservation.

Ongoing Recycling Programs :
1) Mixed Paper; 2) Cardboard; 3) Chemicals; 4) Hospital Equipment;
5) Energy Conservation; 6) X-ray Film

Energy Conservation - We spent over 1,000,000.00 dollars in 1996 on electricity and with your help we want to reduce that amount by at least 5 % - $50,000.00.

Conserve Electricity !

===

Recycling begins with separating and sorting of our trash. If the trash that you are disposing of is not regulated medical waste then chances are "it can be recycled."

$$$$ THE FACTS $$$$

Regulated

Medical Waste - Wet / Saturated with body fluids ~~~~~~~~~~~~ Red Bags Only !

General Waste - All Non-regulated waste ~~~~~~~~~~~~~~~~ Clear Bags Only !

* *

Disposal cost of waste - Medical Waste .... $ 500.00 per ton.
General Waste .... $ 50.00 per ton.

By thinking before we throw our trash in the wrong container we can save thousands of dollars in waste disposal expenses and at the same time increase our recycling inventory.

The Recycling Committee is asking that all employees, present and new, co-operate in anyway they can to make the recycling of ongoing and future recycling programs a success. Please check bulletin boards and e-mail for up-dates.

************* LET'S USE OUR RESOURCES TO THE FULLEST *************

Scott A. George
Recycling Coordinator
Cape Cod Healthcare Inc.

Sample

Most of what we do and how we save money with our Recycling programs is based on TEAMWORK ! Each program needs the cooperation of key personnel in order to succeed and progress.

Key players in "Hospital Recycling" programs:

Paper Recycling
1) Environmental Services
2) All employees
3) Staff Educator
4) Recycling Vendor (Bins and Boxes)
5) Materials Management

Cardboard Recycling
1) Central Distribution
2) Food Services
3) Warehouse / Stock rooms
4) Dock Management
5) Environmental Services

Xylene Recycling
1) Lab management
2) Lab personnel
3) Purchasing

Bio-hazardous Waste Reduction
1) Infection Control Nurse
2) Staff Education
3) O.R. Staff
4) Environmental Services

In all cases when starting a Recycling program it is suggested that a limited pilot program be put in place before a full scale project starts. This will give you a chance to work out the problem areas.

It is also very important that you have an employee in place that can maintain and monitor programs that are in place.

Other key personnel:
1) Local Fire Department
2) Environmental Protection Agency
3) Fire and Safety Manager

Notes:

Scott A. George
Recycling Coordinator
Cape Cod Healthcare Inc.

Sample

Subject: Recycling of waste materials

Purpose: To recycle waste materials for the purpose of lowering the environmental impact and reducing financial burdens.

Policy: To preserve our environment and use our resources to the fullest,

Statement: Recycling will be part of our daily processing.

Procedure: A. The recycling of paper is done hospital-wide.

1. Brown bins will be placed in all departments.
    a. A list of acceptable paper for recycling will be attached to each bin.
    b. Small collecting boxes will be used to collect paper at the desk.
    c. Boxes are emptied into the recycling bin by the desk occupant.

2. When the bin becomes full, assigned department personnel will call Support Services, ext. 2496 or ext. 2468.
    a. Support Services will then bring the full bin to a central location and return with an empty bin to the same location.

3. It will be each department's responsibility to notify Support Services if extra bins are needed for purging of files and/or records - X2468.

B. Cardboard boxes will be transported to the loading dock and placed in the baler for recycling. Transporting of cardboard boxes to the loading dock will be done by Support Services or by individual depts. as previously arranged.

C. Fluorescent Lighting - all spent bulbs will be returned to their original packaging or placed in holding container designed for the transporting of recyclable bulbs. Holding containers and spent bulbs returned to their original packaging will be kept in a separate clearly marked room for recycling.

D. Future recycling items will be added to this policy.

APPROVAL:

____
Director, Environmental Services

____
V.P.- Clinical & Support Services

____
Recycling Committee Chairman

***Scott George** is the recycling coordinator at Cape Cod and Falmouth Hospitals. He is also a member of the U.S. E.P.A. Wastewise Program and the Massachusetts Healthcare Recycling Council. He can be contacted at Cape Cod Healthcare Inc., 27 Park Street, Hyannis, Massachusetts 02601. Phone: (508) 771-1800 X 2472. Fax: (508) 790-4657.*

Victoria Jas, M.S., C.E.T.
Dartmouth-Hitchcock Medical Center
Lebanon, New Hampshire

Facility-Wide Approach to Reducing Toxics Use

This session explores the methods available to reduce toxics in a health care setting from a facility wide perspective. A holistic approach to managing these resources is necessary in light of changes in the industry, regulation, cost, liability and general demand from the public and others to "do things right". The connection between those who provide health care and those who care about the environment has never been stronger. A shift has occurred from the command and control approach to regulatory management that was prevalent in the 1980's. We now live and work in an environment which demands quality care at a lower cost, and still maintains compliance.

Health care facilities are now able to utilize information garnered from other industries which have for years been required to comply with environmental and health and safety regulations. A misperception that hospitals are "above" compliance still exists in some parts of the country even as the media reports that some aspects of healthcare, such as the disposal of medical waste, have a huge potential to pollute the environment.

Matching the unique nature of a health care facility to compliance with regulations -- originally written for industries which created "things" instead of providing medical care to people -- has been challenging. The increasing complexity of the field, which has grown from just managing trash now includes quality improvement and assurance, as well as "beginning-of-the pipe" (demand-side) management concerns. Practitioners are now also involved in abatement of heavy metals and asbestos, water and energy conservation, and health and safety programs. They may all now fall under the general responsibilities of the environmental manager.

Definitions

For purposes of general discussion, the term "toxics" includes chemical (such as hazardous materials) and biological (such as pathological waste) materials. Toxics reduction includes, but is not limited to waste minimization, life cycle costing and resource conservation. The confusion over terminology indicates that much more consistency needs to occur before many of these approaches to toxics reduction can be effectively implemented. Clarifying the words used to describe activities is often the first step in making changes occur, since all parties need to be clear on what exactly is being changed.

Identifying priorities is as important as defining terms. The "big picture" can be viewed with clarity, purpose and vision when priorities are clear. Written documents such as environmental principles or mission statements are important methods to formalize reduction efforts, as well as to provide a baseline for performance expectations. This type of approach can provide philosophical guidance and to create an internal audit and compliance function.

Understanding the goals which drive internal decision making is crucial when working with limited resources and time. Recognizing the unique nature of the health care industry and internal and external drivers is important. Establishing selection criteria can assist in the establishment of priorities; such as cost, operations, confidence, compliance, quality, environmental stewardship, and regulatory compliance.

The Whole Facility Approach

There are two approaches to toxics reduction. The first includes an overall assessment, or a quantitative audit to establish a bench mark. This approach is usually generated by regulators, insurers, or in mitigation of a negative outcome such as an accident. Facilities that begin the process of toxics reduction by spending large sums of money, time and energy are rare in this economic climate. However, this approach has validity as regulators are examining more holistic approaches to managing environmental resources. This approach is being seen in the Joint Commission 1998 "Environment of Care" standards, which are performance driven and quite comprehensive. These large scale approaches are not easily accessible to those unfamiliar with pollution prevention on a facility wide basis or can be cost prohibitive to many. Facility wide issues include: establishing goals and objectives, developing selection criteria and support, and incorporating appropriate technology.

1. Goals and Objectives

The process of writing and incorporating statements which aspire to or define expected performance can be beneficial in changing behavior. In toxics reduction, this process requires both full administrative support -- willingness to "walk the talk"-- if a principles statement is going to be used for more than a dust collection device.

The enclosed statement required almost a year and eight draft versions to gain full administrative support. Much of it seems at first glance obvious and appropriate. Working against its approval was the perceived cost -- without administrative controls-- associated with adoption. It is an ideal time to educate and introduce the concept that conservation-- be it of resources, time or energy-- SAVES money. Administrators and environmental managers have the same concerns. This recognition of shared commitment assisted in the passage of this specific statement.

Victoria Jas, M.S., C.E.T.
Dartmouth-Hitchcock Medical Center
Lebanon, New Hampshire

A disconnect can occur at the point which environmental managers need to justify initial investment and return. Traditional training tells us that we need to do “x” project because 1) regulators mandated it, or 2) it is a good idea. Both of these statements are derived from a command and control approach to environmental management, which is outdated and no longer effective. Project “x” may get done, but only to a certain extent. A more pragmatic approach may be very useful: using cost and benefit analysis accomplishes two things: first, it speaks a familiar language to administrators, and secondly, it works from an “opportunity” standpoint.

The enclosed example of an environmental principles statement initially had one primary goal: to unite three individual facilities (a hospital, clinic and medical school) in operating in a consistent manner as it related to environmental management. From this process rose an “Environmental Resources Committee”, representing the three facilities and providing oversight, guidance, and feedback to all toxics reduction activities in the facility.

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Dartmouth-Hitchcock Medical Center
Lebanon, New Hampshire

STATEMENT OF ENVIRONMENTAL PRINCIPLES DARTMOUTH HITCHCOCK MEDICAL CENTER
1998

In an effort to promote healthier communities both locally and globally, Dartmouth-Hitchcock Medical Center (DHMC) is committed to improving environmental management throughout the organization. DHMC will manage its operations in a manner demonstratively protective of environmental and human health.

DHMC will constantly seek new and better ways to meet its environmental goals through conservation, reduction, reuse and recycling programs, and through partnering with others in the community to safeguard the environment.

These principles will provide DHMC with criteria by which to balance these environmental objectives with other institutional and financial considerations.

In an effort to respect and protect the earth's resources, and to minimize environmental damage, DHMC will:

- Manage, minimize and eliminate, whenever possible, the use of hazardous materials.
- Use renewable natural resources and conserve non-renewable natural resources through cost efficient use and careful planning.
- Use pollution prevention initiatives to reduce negative environmental impacts.
- Minimize the generation of waste through source reduction, re-use and recycling programs.
- Conserve energy and improve the energy efficiency of our operations and make every effort to use and promote environmentally safe, cost-effective and sustainable energy sources.
- Ensure the health and safety of our employees by promoting safe work practices, reducing exposure, using safe technologies, and implementing effective emergency preparedness programs.
- Provide employees with safety and environmental information through training and education programs in order for them to make work/practice decisions in support of these principles.
- Monitor and evaluate our practices as they relate to these environmental principles.

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Dartmouth-Hitchcock Medical Center
Lebanon, New Hampshire

2. Developing Selection Criteria in Decision Making

Identifying the factors which will consciously drive a decision making process is critical in making it effective. Weighing, or "screening" of these priorities helps keep the decision making process on track and prevent an immediate sense of being overwhelmed, especially as toxics reduction efforts are first initiated. Working in a group process, it is helpful to examine what issues are most important in any specific approach. Has a facility been told to cut 10% from its operating budget? Has a new regulation been promulgated which significantly impacts operations, such as a new industrial discharge permit? Are new methods now available to process instrumentation with less exposure to employees?

One example of a project examined methods to reduce and manage infectious waste using an alternative technology. Personnel involved in the decision making process were asked to examine and state their motivations and concerns. Cost as the driving decision maker isn't always the sole priority once all the issues are on the table. In one example, the need to be independent in handling one's own system became a surprising, illuminating and refreshing criteria This independence drove a decision to purchase autoclaves to manage infectious waste, and ultimately became a source of pride. This pride also sparked a renewed ownership and commitment to reducing waste in general, which translated into directly quantifiable waste and cost reductions.

3. Incorporating Alternative Approaches in Pollution Prevention

The saying "you can't see the forest for the trees" is very relevant when discussing toxics reduction opportunities. A narrow focus can eliminate the ability to see the whole problem. An incinerator shutdown put a facility into a tailspin as they tried to put an immediate fix into place to address the unexpected cost of shipping waste off-site for processing. The facility managers examined incinerators and other machines that would treat their waste. Much focus was placed on visits to other facilities, looking outward to solve the problem. The focus on the immediate issue missed the real problem: the facility was generating waste at four times the regional average. By examining their definitions as well as waste stream, they cut their costs by 75% before they had to commit to another disposal technology, system or vendor. There is much discussion and attention to "alternative technology", but perhaps "alternative approach" is a more descriptive term as it includes change in process as an option. Leaving options open for future opportunity is helpful. Once the volume of waste was reduced significantly in this example, then the remaining amount could be handled by a technology that was size-appropriate. The facility almost purchased a technology sized to accommodate four times the capacity than was necessary at a much higher cost.

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Dartmouth-Hitchcock Medical Center
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Specific Opportunities in Toxics Reduction

Perhaps the more common and accessible approach to those new to toxics reduction involves the appreciation for the whole, while seeking opportunities in specific areas and slowly learning and building from both failures and successes. Specific projects can provide an opportunity to understand the intricate framework from which a facility operates financially and politically as well as incorporating the recognized (and less recognized) individuals who make change happen in their areas of responsibility and/or expertise.

1. Infectious Waste Minimization

Perhaps more than any other opportunity to directly impact cost, safety and environmental impact is to reduce infectious waste because of its significant potential to harm people, as well as cause concern to those outside the health care industry. The facility wide approaches listed above can be utilized in accomplishing this goal. Another motivator to reduce infectious waste is the benefits to the relationship to the community.

In introducing reduction efforts, education, containers and employee compliance are easy targets for change. What often happens is that the problem lies in how materials are handled, especially in labor allocation. The problem quickly can become more complex, requiring additional review of the organizational system of handling materials and waste. The interconnections between handling and disposal become more and more important. Several excellent references already exist to assist in reducing infectious waste. They include "An Ounce of Prevention: Waste Reduction Strategies for Health Care Facilities" by the American Society for Health Care Environmental Services (1993) and "Environmental Management in Health Care Facilities" by Kathryn D. Wagner (1998).

2. Proactive Approaches in Environmental Management

Another toxics reduction opportunity lies in product substitution. Ethylene oxide is an extremely hazardous material commonly used as a gas sterilant in health care facilities. Problems include maintaining inventory, handling the gas, environmental monitoring, and projecting the costs of future control technology. These concerns caused one hospital to explore replacing ethylene oxide with alternative technologies, work practices, and introduction of compatible instrumentation. It required committing to phasing out the use of this sterilant in a federal permit application in order to maintain existing environmental compliance.

The cost of air, personnel and leak monitoring would be avoided by this change. Product substitution would allow for less down time for training and emergency drills. It would free employees from the fear of leaks or off-calibration false alarms. But it would also require extensive cooperation with clinical staff to understand, appreciate and resolve their issues regarding a significant change in protocol, FDA and internal infection control approvals of alternative technologies and change in handling reusable instrumentation.

The substitution is almost complete for this facility and represents the first of its kind in its region.

3. Life Cycle Cost

Identifying the real cost to a facility of the entire life cycle of a product can be very effective in specific areas which represent opportunities for toxics reduction. Mercury is an excellent example. The purchase cost of a mercury thermometer is very low. The safest disposal for elemental mercury is triple distillation recycling, which is very expensive and requires that thermometers be collected, transported and delivered intact to a hazardous materials recycling facility and processed. It requires tracking of paperwork and other regulatory requirements on an ongoing basis. This can triple the whole life cycle cost: from the point to sale to ultimate disposal. Educating purchasers and users is critical in reducing toxics such as mercury from the health care setting, and should go together with discussions regarding mercury toxicity that many communities are now having. Identifying all devices which contain mercury compounds can be an excellent specific toxics reduction opportunity, as almost all compounds have a less expensive alternative on a life-cycle cost comparison. These devices are used in many locations and can be an excellent first step in a facility wide program to identify and reduce toxics in a health care setting.

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Massachusetts Hospital School
Department of Public Health

Environmental Stewardship: Meeting our environmental responsibility & regulatory requirements through JCAHO Environment of Care management plans

The Massachusetts Hospital School – an overview

The Massachusetts Hospital School is a Department of Public Health, JCAHO accredited pediatric rehabilitation hospital. We serve as both a hospital and a school for physically handicapped children. It is part of our mission to demonstrate leadership and to manage our facilities with programs that reduce potential exposures and risks to our patients, students, employees, and the community.

The campus includes 24 structures with a combined total of 480,000 square feet of floor space including school buildings, administration buildings, gymnasium/pool, hospital and residential buildings located on Old Reservoir pond - with 161 acres of land.

Buildings have been constructed over a period of 80 years. All are supplied with heat and electrical power distribution from a boiler plant commissioned in 1982.

The school portion of the program follows a fairly standard school year schedule (with summer program usage 6 - 7 weeks each summer). The hospital has 110 beds and operates 24 hours each day throughout the year. Administrative buildings are open weekdays during normal business hours.

Boston Edison through 13.8 kV feeders provides electrical service. The majority of the electrical distribution throughout the campus is supplied through 4160 Volt lines from the new boiler plant - electrical distribution panels.

There are two standby diesel generators in the power plant. One is rated for 400 kW at 4160 Volts supplying several 4160 Volts feeders and a smaller unit rated for 180 kW at 480 Volts supplying four buildings and the Plant itself. There are two additional back up generators on campus - a 27 kW diesel located in the hospital building, and a 30 kW natural gas generator located in one of the school buildings.

Space heating and domestic hot water heating requirements are met using steam supplied by 2 Cleaver Brooks watertube boilers (rated for 20,000 lbs./hour at 150 psig). Domestic hot water is produced locally using steam coils in hot water storage tanks. Another boiler, a smaller Kawanee fire tube boiler (rated for 10,000 lbs./hour at 150 psig) is used during low load seasons.

Air conditioning loads are met by a combination of electrical Direct Expansion systems, an absorption chiller (190 tons), and a natural gas energized chiller).

To improve the facility's energy resources, a 252 kWh turbine generator has been installed (1/95). Design parameters would allow this generator to operate with reduced loads down to 47 kWh. Piping and PRV modifications were made to convert the high-pressure distribution steam network - to a low pressure network (except for a high pressure sterilizer line).

JCAHO – Environment of Care Standards

The JCAHO accreditation process has provided us with the opportunity, through the Environment of Care Standards, to establish and build the framework of environmental stewardship management plans into our organizational life. The intent of the Environment of Care Standards (EC) is defined in the JCAHO – CAMH Refreshed Core, January 1998 manual as:

Effective management of the environment of care includes using processes and activities to: *reduce and control environmental hazards and risks; prevent accidents and injuries; and maintain safe conditions for patients, visitors and staff*

We have, over the past 6 years, built into our EC management plans, environmentally responsible processes. We have expanded the traditional interpretation of the intent to include pollution prevention, resource conservation and innovation in environmentally gentle technologies and practices, as vital and linked aspects of our plans, daily operations and organizational values.

The EC management plans, developed and formalized through the facility Safety Committee, become accreditation driven management objectives. The plans receive facility validation and support through the Hospital's performance improvement processes, strategic planning and the budget (capital & operational).

Performance Improvement & environmental stewardship

Our facility uses the performance improvement model of:

- Plan
- Do
- Check
- Act

As with other organization priorities and initiatives, environmental opportunities to improve are developed using this model.

Plan

- Gathering data at the beginning of the design phase
- Research what are our present practices & best practices in our and other industries
- Involve local authorities having jurisdiction (Fire Departments, Public Safety inspectors, Conservation Committees, etc.)

Do

- Hire a Licensed Site Professional to complete an environmental audit
- Review environmental audit and implement plans to conform with or exceed regulatory requirements
- Understand impacts – beyond regulatory issues – develop plans that incorporate environmentally responsible facility management
- Develop plans to fix regulatory issues – link with Strategic Plans & Capital budgets

Check & Act

- Implement & evaluate plans that fix/define/improve impact on non-regulatory issues
- Report findings to Performance Improvement
- Obtain certificate of compliance's, certificates of inspection or permits to operate – as required

Beyond the intent of the EC Standards, several of the standards – requiring management plans, provide opportunities to incorporate environmentally responsible initiatives.

Sustainable design and specifications

EC 1.2

When designing the environment of care, the organization uses design criteria referenced by the health care community.

References used by health care organizations must include not just regulatory and code related sources – but references that focus on the environmentally important aspects of health care's environmental responsibility. The planning phase of implementing EC management plans, with environmentally responsible inclusions, is the time to incorporate opportunities for future improvements. Linking capital construction and budgets and strategic planning at this phase is essential.

Some steps to take when planning renovations or new construction could include:

- Design space for recycling containers, compactors, balers, loading docks, separate closets

- Incorporate occupancy sensors – for lighting, heating & cooling systems
- Exterior lighting that is efficient, but also controllable and designed with insect reduction or redirection in mind
- Staff shower facilities and bicycle racks
- Maintenance of existing habitat for birds
- Landscaping that is drought tolerant, native, compatible
- Alternative energy sources

Simple environmentally responsible design ideas can be included in renovations or new construction. Specifications requiring that engineers or architects – have experience in designing environmentally responsible buildings should be included in the bidding process for hiring engineers or architects. The Commonwealth of Massachusetts – Operational Services Division web page – http://www.osd.com has a copy, on line of specifications that can be included in any bidding document. These sustainable design criteria, including life cycle analysis in the design phase, are ways to integrate the procurement function of hospital operations into environmentally gentle management.

Use the standard of exceeding code requirements for energy aspects of renovations/construction as a baseline. Opportunities for utility sponsored rebates and partnering with companies looking for pilot locations for innovative technologies are cost saving opportunities that can help offset capital costs.

This is also the time to broadly interpret a project as a piece of work linked to past construction/renovations, present operations and future construction and operations. We define our capital improvements as phases of work. An example is to incorporate valves, piping or control points in a present design - to be used in the future to allow for the easy connection as a potential back up for an aging one. Another example is the inclusion of standpipes, valves and piping into buildings, during a water line improvement project – for future use for sprinkler installation.

Procurement as a partner in environmental stewardship

Another step is to incorporate as many environmentally responsible requirements in all procurement specifications. The JCAHO standard, which formally recognizes the importance of purchasing on the Environment of Care, is:

EC 1.7 A management plan addresses life safety

c. Reviewing proposed acquisitions bedding, window draperies, and other curtains, furnishings, decorations, wastebaskets, and other equipment for fire safety

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Department of Public Health Steps to take include:

- toxic reductions – reduce quantity
- recycling (cradle to new cradle approach – part of the loop)
- mandate that specifications for any hazardous waste contractor – include unannounced site visits to their plants and that – inspection of transport vehicles provided by contractors – will also be inspected
- build in information collection from vendors, into contract – build in training
- Automotive fuel – transportation alternatives
- Solid waste management
- Recycling
- Buying recycled
- Waste stream management
    - Office paper
    - Corrugated
    - Steel & aluminum cans
    - Glass – all colors
    - Plastics (various types)
    - Co-mingled design
    - Phonebooks
    - Construction debris
    - Construction salvage
    - Surplus property process
    - Re-use packaging material

Pollution prevention – hazardous materials

A standard that clearly speaks to environmental responsibility is:

EC 1.5 A management plan addresses control of hazardous materials and waste. selecting, handling, storing, using and disposing of hazardous materials and waster from receipt of generation through use or final disposal .

Steps to take and areas to integrate into this standard (in an outline form) include:

- Update existing contracts and facility operations to change from a pest extermination contract to an Integrated Pest Management program. There are cost saving opportunities and environmental impacts involved. A great reference for IPM is available on the World Wide Web at the Commonwealth of Massachusetts Department of Food and Agriculture – Pesticide Bureau web page (www.massdfa.org) – IPM Kit for Building Managers

- Toxic reduction
  - Change process or equipment to reduce waste generated Increase efficiency of existing process or associated equipment to reduce usage of toxic material
  - Use a different material to do the same process – to minimize impact of toxin
  - Use "Green" Housekeeping chemicals
    Great references include:
    Guidelines for Green Building Housekeeping and Maintenance
    Rochester Midland Corporation, 1995

    Environmentally Preferable Cleaners - Product Health & Environmental Specifications and Checklist
    Request for Proposal - Environmentally Preferable Cleaners - RFR # GR004
    Commonwealth of Massachusetts
    Operational Services Division – World Wide Web Page -
    http://www.osd.com/enviro/enviro.htm

- Develop Spill Containment & Countermeasure Plans – even if not required to do so by regulation
- Water quality and conservation
  - Waste water monitoring, flow & metering
  - Install pool covers – especially in heated in-building pools
- Indoor air quality
- Yard/landscape waste & composting
- Purchasing items without PVC contents (if available)
- Energy management
- Electrical efficiency

Outcomes

The Massachusetts Hospital School has realized positive economic, regulatory, public relations, and environmental benefits directly related to the pollution prevention initiatives we have instituted. We have received Federal Environmental Protection Agency and Commonwealth of Massachusetts recognition for these efforts. These pollution prevention initiatives are easily duplicable by other health care organizations.

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Practical P2 Applications in the Hospital: Children's Hospital of Wisconsin Case Study

In the 1980's, there was widespread concern about medical waste due to media reports of syringes found on public beaches. Although Wisconsin chose to not participate in the federal medical waste program, it had concerns of its own. Public opposition to new commercial incinerators was high. A 1991 study revealed that the state had capacity to treat more infectious waste than it generated and that many of Wisconsin's 150 medical waste incinerators were legally burning recyclable waste along with their infectious waste under an exemption in the state's recycling law. Outside the healthcare sector, sharps injuries were increasingly common among waste handlers, and recyclable materials were being sent to landfills due to the actual or suspected presence of sharps.

To address the environmental and safety concerns, the state legislature established a moratorium on new regional medical waste incinerators and asked the Department of Natural Resources (DNR) to write rules for managing and reducing medical wastes. DNR invited healthcare providers, environmental groups, waste haulers and others to help write the rules, which were adopted in 1994. These rules required hospitals, clinics and nursing homes ("medical facilities") to write and implement plans to reduce the amount of medical waste being generated. Rather than mandate percentages of reduction, the rules require each medical facility to audit its waste, develop and implement its own plan, set its own goals and choose how to meet the goals within its own context. The plans must include elements common to successful waste reduction programs of all kinds. For example, each facility must commit to the waste reduction hierarchy, examine potential cost savings, consider impacts on patients, improve waste handling practices (e.g., source separation), evaluate purchasing practices (such as alternatives to the use of disposable items), train employees annually, and consider internal incentives.

In 1994, Children's Hospital of Wisconsin embarked upon an ambitious program to reduce wastes and prevent pollution throughout their facility. Using their safety committee as the initiator, hospital top management was garnered. With the assistance of the University of Wisconsin-Extension's Solid and Hazardous Waste Education Center, a waste audit of the facility was conducted, which identified opportunities for pollution prevention, especially in the usage of toxic chemicals, including mercury. Each area of the facility was targeted with a specific pollution prevention strategy, with operational managers charged with implementation. The following are key findings of this effort:

- Essential components for a successful pollution prevention program must be in place, including top management support, team history of successful work, knowledgeable and committed staff, and a materials management policy, including risk assessment;

- Targeting "low hanging fruit" (e.g., thermometers) leads to early success, allowing for more difficult follow on challenges;
- Low risk mercury containing items can be phased out over time;
- Solvent recovery is easy to implement and very cost effective; and
- Alternative, non-mercury containing products are often cheaper and as effective.

Implementation of a pollution prevention program has reduced risk and improved profitability at Children's Hospital. Additional initiatives that have resulted from the Children's Hospital pollution prevention program include the:

- Development of a "trigger" screening database that will link purchasing decisions with material data sheets and other toxics databases to screen for less toxic products;
- On-going mandatory staff training; and
- Recognition as a Governor's Waste Minimization award winner.

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Section 3: Laboratories

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More detailed information about these efforts has been published by Dr. Denys in Pollution Prevention and Waste Minimization in Laboratories, edited by Reinhardt, Leonard and Ashbrook and published in 1996 by CRC Press.

Waste Minimization in the Clinical Laboratories

Gerald A. Denys, PhD

Clarian Health/
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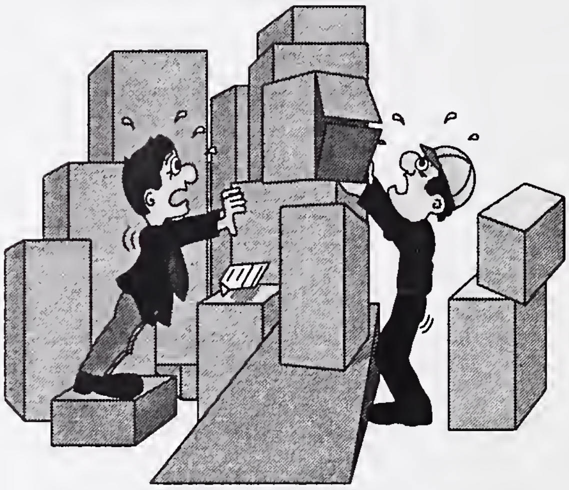
October 7, 1998



Objectives

- Discuss Management Practices to Minimize Waste Generation
- Identify Ways to Reduce Waste Through New Technology and Product Substitution
- Discuss the Reuse of Wastes
- Review Components of a Waste Reduction Program

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Considerations for Waste Minimization

- Regulatory requirements to reduce and minimize the quantities of waste generated
- Cost savings; smaller quantities of waste to manage and dispose.
- Cost savings; some waste are reused or recycled
- Increase environmental awareness
- Institutional concerns about community relations.

According to 40 CFR 262.41 (the Resource Conservation and Recovery Act), each generator of hazardous waste must undertake efforts to reduce the volume and toxicity of waste generated. This effort is certified each time the generator signs a manifest for the transport of hazardous waste.

Minimization of Waste Through Management Practices

- Formalize a Strict Definition of Waste Type
- Implement Source Separation of Different Waste Types
- Institute a Product Substitution Policy
- Utilize computers or software to help track and manage waste

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Implementation of Source Separation

- Infectious Wastes
- Chemical Wastes
- Radioactive Wastes
- Multihazardous Wastes
- Wastewater
- General Wastes (Amenable to Reuse or Recycling)

Categories of Infectious Waste

- Microbiology and Pathology Waste
- Blood and Blood Products
- Contaminated (Unused) Sharps
- Culture,Stocks, Associated Biologicals
- Contaminated Animals, Body Parts, Bedding
- Wastes from Surgery and Autopsy
- Contaminated Equipment
- Contaminated Laboratory Wastes
- Dialysis Unit Wastes

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Chemical Wastes Separation

- Chemicals suitable for disposal to sanitary sewer
- Chemicals that can be redistilled for reuse
- Solvents that can be incinerated for heat recovery
- Hazardous chemicals that can be treated to neutralize
- Hazardous chemical wastes that are regulated by RCRA that cannot be treated or disposed of on-site

Other Waste Suitable for Reuse or Recycling

- Paper (e.g.computer, newspaper)
- Plastics (e.g. petri dishes, culture tubes)
- Aluminum (e.g.cans)
- Glass (e.g. bottles, slides)
- Packaging materials and containers (e.g. Styrofoam, corrugated cardboard, plastic wrappers and containers, wooden pallets)

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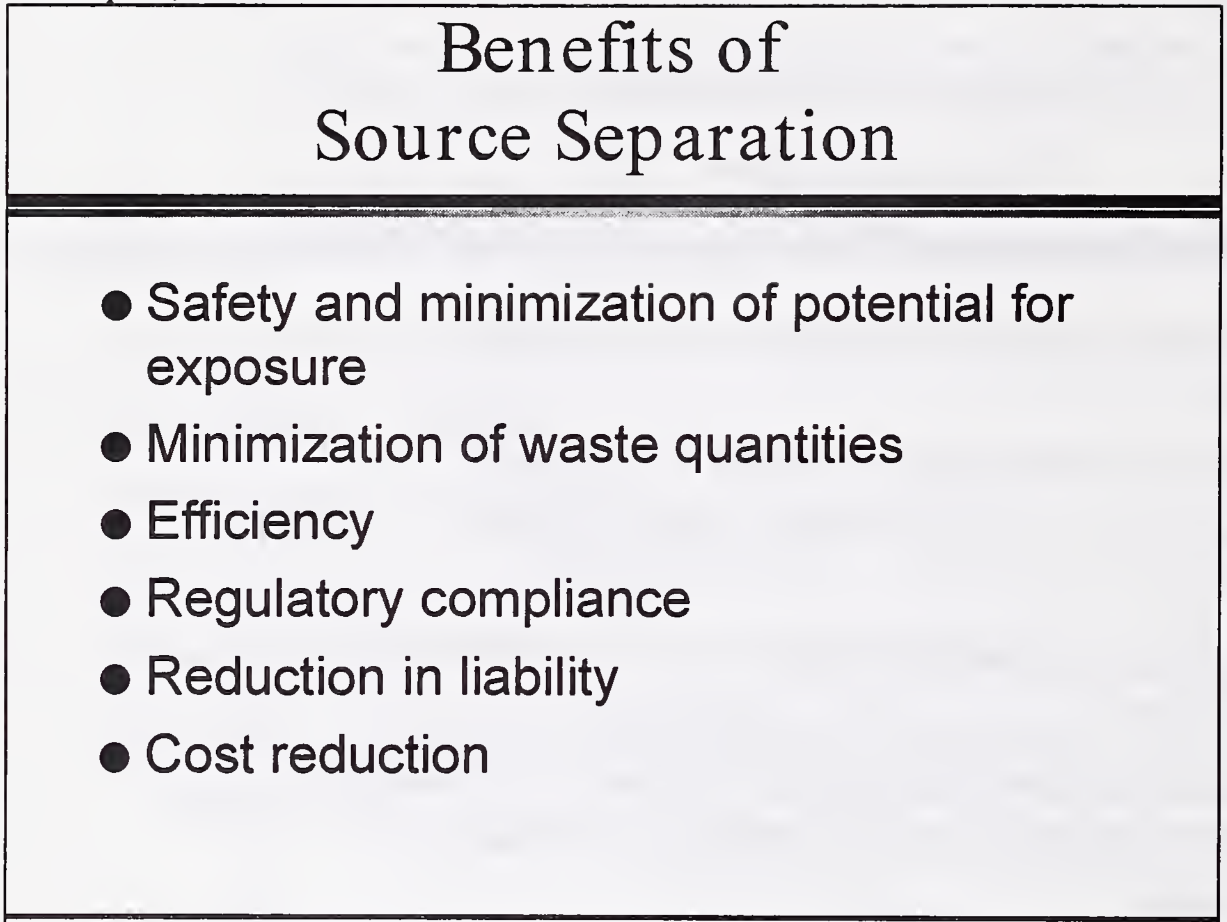
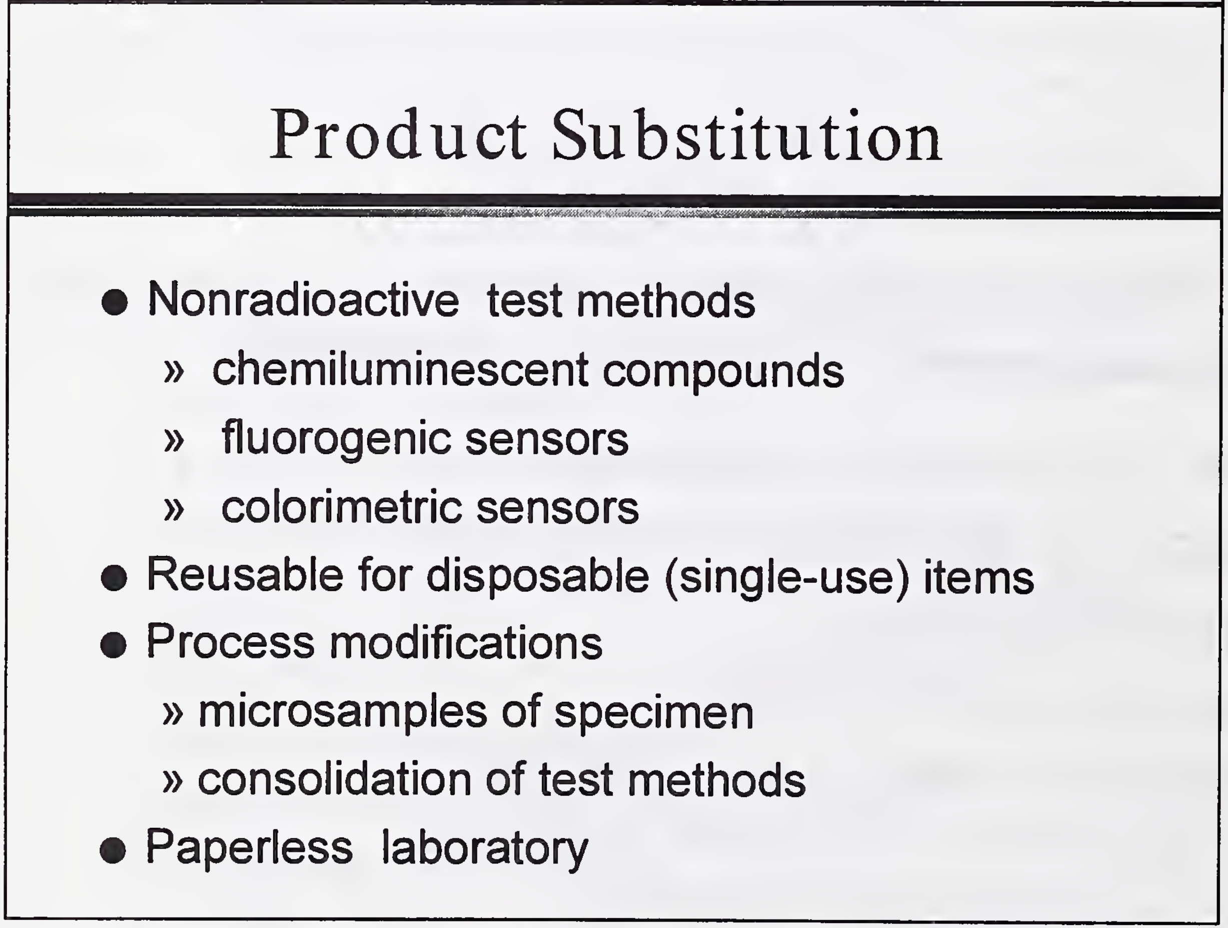


Benefits of Source Separation

- Safety and minimization of potential for exposure
- Minimization of waste quantities
- Efficiency
- Regulatory compliance
- Reduction in liability
- Cost reduction



Product Substitution

- Nonradioactive test methods
  - » chemiluminescent compounds
  - » fluorogenic sensors
  - » colorimetric sensors
- Reusable for disposable (single-use) items
- Process modifications
  - » microsamples of specimen
  - » consolidation of test methods
- Paperless laboratory

Nonradioactive Methods: - Microbial Detection:
Bactec 9240 (Becton Dickinson Diagnostic Instrument systems) (fluorogenic sensor)
BacT/Alert (Organaon Teknika Corp) (colorimetric sensor)
Microorganism Gas Consumption and Production:
ESP system (AccuMed)

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Hazardous Reagents Substitution

- Mercury-containing reagents
  - » ion-selective electrodes replaces mercuric nitrate for chloride determination in body fluids.
  - » electronic apparatus replaces lab thermometers
- Sodium lauryl sulfate provides alternative to cyanide methods for automated hemoglobin analysis
- Cupric sulfate substitutes for mercuric chloride as a fixative for PVA/trichrome stain
- Substitute nonsilver stains for silver stains

Minimization of Waste Through New Technology

- Microbiology
- Immunology
- Chemistry
- Hematology

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Notes to Slide 12

New Technologies To Minimize Toxic and Hazardous Waste

Microbiology:

Micromethods reduce the amount of sample and reagents required. Micromethods for identification of antimicrobial susceptibility of microorganisms include:

API system (bioMerieux Vitek, Inc.)
Biology system (Biolog, Inc.)
BBL Crystal system (Becton Dickinson Microbiology Systems)
Raid ID systems (Innovative Diagnostic Systems, Inc.)

Some instruments combine identification and antimicrobial test panels which reduce the quantity of waste and make testing more efficient. Examples of automated walkaway identification and susceptibility instruments are:

Dade MicroScan system (Dade International)
Vitek System (bioMerieux Vitek, Inc.)

(The Vitek system requires smaller test volumes and fewer preparation devices.)

Rapid screening tests can eliminate specimens that need not be cultured; these methods often generate less waste than conventional methods. Rapid urine screen methods utilize the enzyme dipstick, filtration, bioluminescence, chemiluminescence, and photometry.

Rapid screen tests for bacterial identification include:

Butyrate esterase disc test for Moraxella catarrhalis
PYR disc test for Streptococcus yogenes
PYR disc test for Group D enterococci
Rapid urease test for Helicobacter pylori.
Spot indole test for Escherichia coli

DNA probe-based tests can be used as alternatives to confirmatory tests. The Accuprobe culture confirmation test for mycobacteria (Gen-Probe, Inc.) is one such test which can eliminates conventional biochemical testing.

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Molecular Diagnostics:

DNA amplification techniques can allow for direct specimen testing and further reduce infection wastestreams by eliminating unnecessary cultures.

PCR (polymerase chain reaction, Roche Molecular Systems)
TMA (transcription mediated amplification, GenProbe, Inc.)
DSA (strand displacement amplification, Becton Dickinson Microbiology Systems)
LCX (ligase chain reaction, Abbott Laboratories)

Immunology/Serology:

Consolidation of test methods minimizes quantities of waste generated. These systems conduct several different immunoassays simultaneously.

IMX (Abbott Laboratories)
ACS-Centaur, Automated Chemiluminescence System (Chiron Diagnostics)

Chemistry/Hematology:

Automated analyzers which require only microsamples of specimen also reduce the amount of reagent used. Examples of these include:

Dade Dimension RXL Clinical Chemistry System (Dade International; encapsulates waste)
Sysmex Hematology System (Sysmex)
Sysmex CA-6000 Coagulation System (Sysmex)

Other options to reduce reagent use and waste generation include:

Ektachem dry slide chemistry analyzer (Johnson & Johnson; eliminates the generation of hazardous waste).
Dako Autostainer Universal Staining System (Dako Corp; separates hazardous from non-hazardous waste)
i-STAT analyzer (i-STAT Corp; analyzes two drops of blood using biosensors to measure sodium, potassium, and other analytes.)

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Federal Regulation Affecting Management and Disposal of Wastes from Medical Laboratories

Waste Type	Federal Regulation	Agency
Infectious	Medical waste tracking	EPA
	Bloodborne pathogens standard	OSHA
Chemical	Hazardous waste management	EPA
Radioactive	Radioactive waste disposal	NRC
Wastewater	Effluent guidelines and standards	EPA

On-Site Treatment of Infectious Waste

- Incineration
- Steam/Autoclave
- Steam/Mechanical
- Chemical
- Electro/Thermal/Radiation
- Microwave
- Pyrolysis/Oxidation

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On-Site Treatment of Chemical Waste

- Recycling for Reuse
  - » Redistillation of used solvents
  - » Incineration of solvents with heat recovery
- Neutralization of acids and bases
- Treatment to destroy or precipitate out hazardous constituents
- Sanitary Sewer System

Implementing a Waste Reduction Program

- Management Program
- Purchasing Strategies
- Employee Awareness Program
- Employee Training
- Cost Savings: Administration Support

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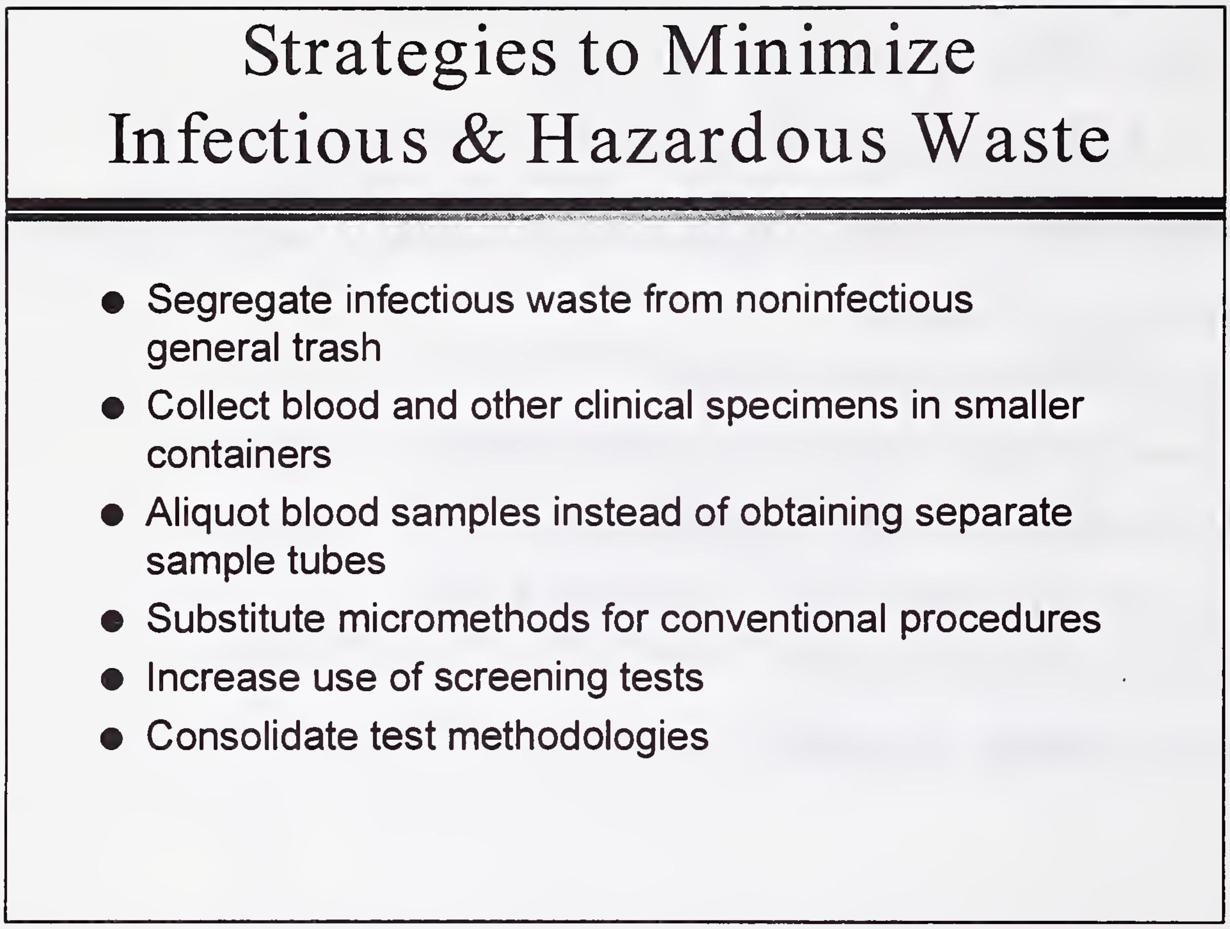
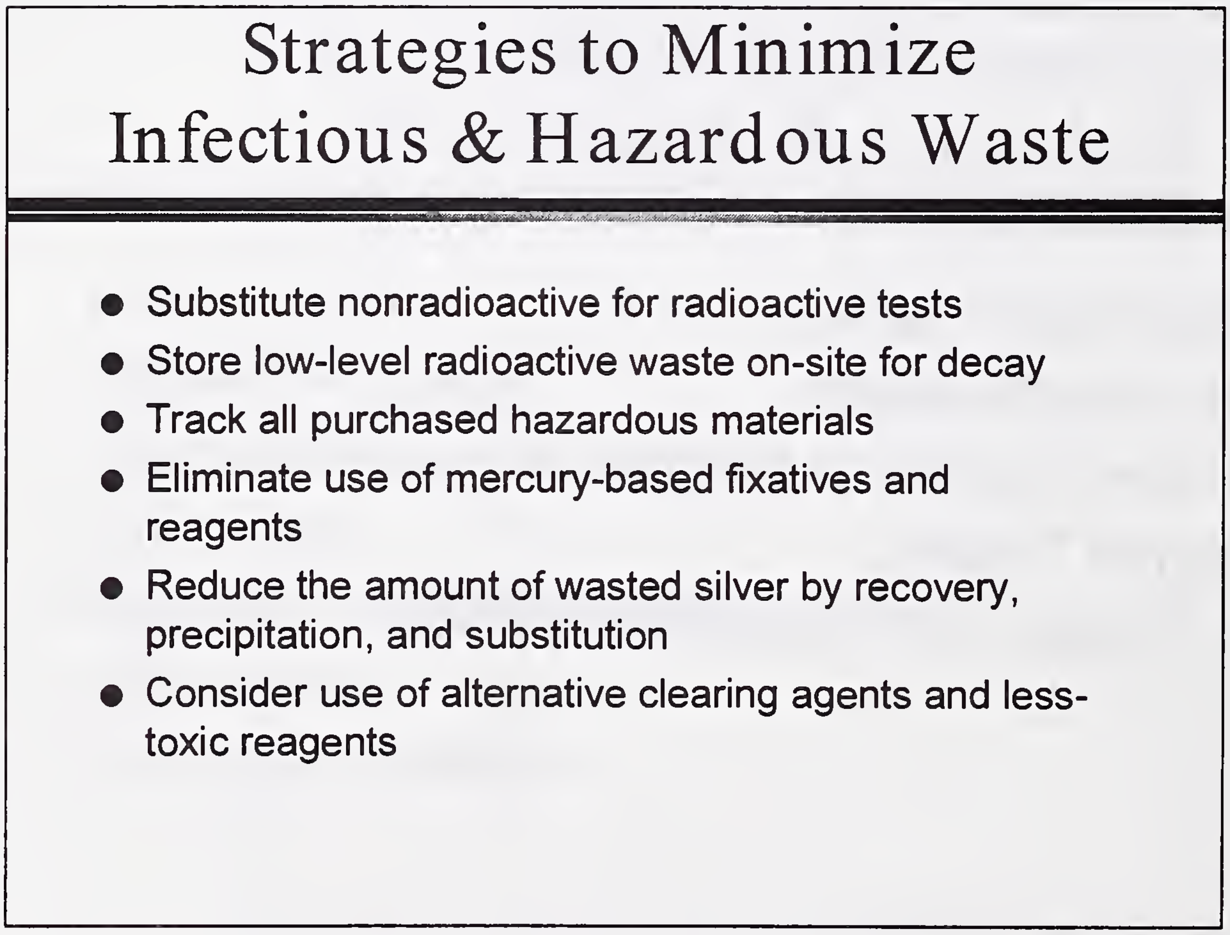


Strategies to Minimize Infectious & Hazardous Waste

- Segregate infectious waste from noninfectious general trash
- Collect blood and other clinical specimens in smaller containers
- Aliquot blood samples instead of obtaining separate sample tubes
- Substitute micromethods for conventional procedures
- Increase use of screening tests
- Consolidate test methodologies



Strategies to Minimize Infectious & Hazardous Waste

- Substitute nonradioactive for radioactive tests
- Store low-level radioactive waste on-site for decay
- Track all purchased hazardous materials
- Eliminate use of mercury-based fixatives and reagents
- Reduce the amount of wasted silver by recovery, precipitation, and substitution
- Consider use of alternative clearing agents and less-toxic reagents

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Strategies to Minimize Infectious & Hazardous Waste

- Distill formaldehyde for reuse
- Distill xylene and alcohol for reuse or direct to a reclamation facility
- Consider alternative waste treatment and disposal option
- Develop an education program to promote recycling, product reuse, and waste reduction

Purchasing Strategies

- Elimination of inner liners and boxes
- Elimination of toxic metals in ink,dyes, and adhesives
- Elimination of chlorine-bleached paper and paperboard
- Elimination of foam packaging made of chlorofluorocarbons
- Maximize use of recycled fiber in corrugated shipping containers
- Reduction in primary, secondary, and tertiary packaging where feasible
- Promotion of bulk shipping and reusable containers
- Adoption of guidelines for the evaluation of new packaging designs

Employee Awareness Program

- Obtain support and cooperation of employees
- Provide information about purpose, scope and benefit
- Provide specific information about wastes that can be reused or recycled
- Provide procedures for handling each of the wastes and importance of following these procedures
- Present information as part of the training program for all employees who generate, collect or handle wastes

Employee Training

- Which wastes can be reused or recycled
- Need for source separation to avoid sorting and maximize the returns from waste minimization efforts
- How to differentiate and segregate different wastestreams
- Designated procedures and why it is important to follow them
- How to maximize the benefits of the program
- Rationale and importance of the waste minimization program

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Practical Cost Benefits Include Reduced Cost for:

- Purchase of supplies when discarded items are recycled and reused instead of new items
- Purchase of solvents when redistilled solvents are used instead of new chemicals
- Treatment, management, and disposal of smaller quantities of infectious waste
- Treatment, management, storage, and disposal of smaller quantities of hazardous and radioactive waste
- Regulatory compliance for management and disposal of smaller quantities of infectious, hazardous, radioactive wastes

Summary

- A successful waste minimization program will help control costs and comply with regulation.
- Waste minimization takes effort and management backing and support to facilitate every step from the initial purchase of a product through proper storage to disposal.

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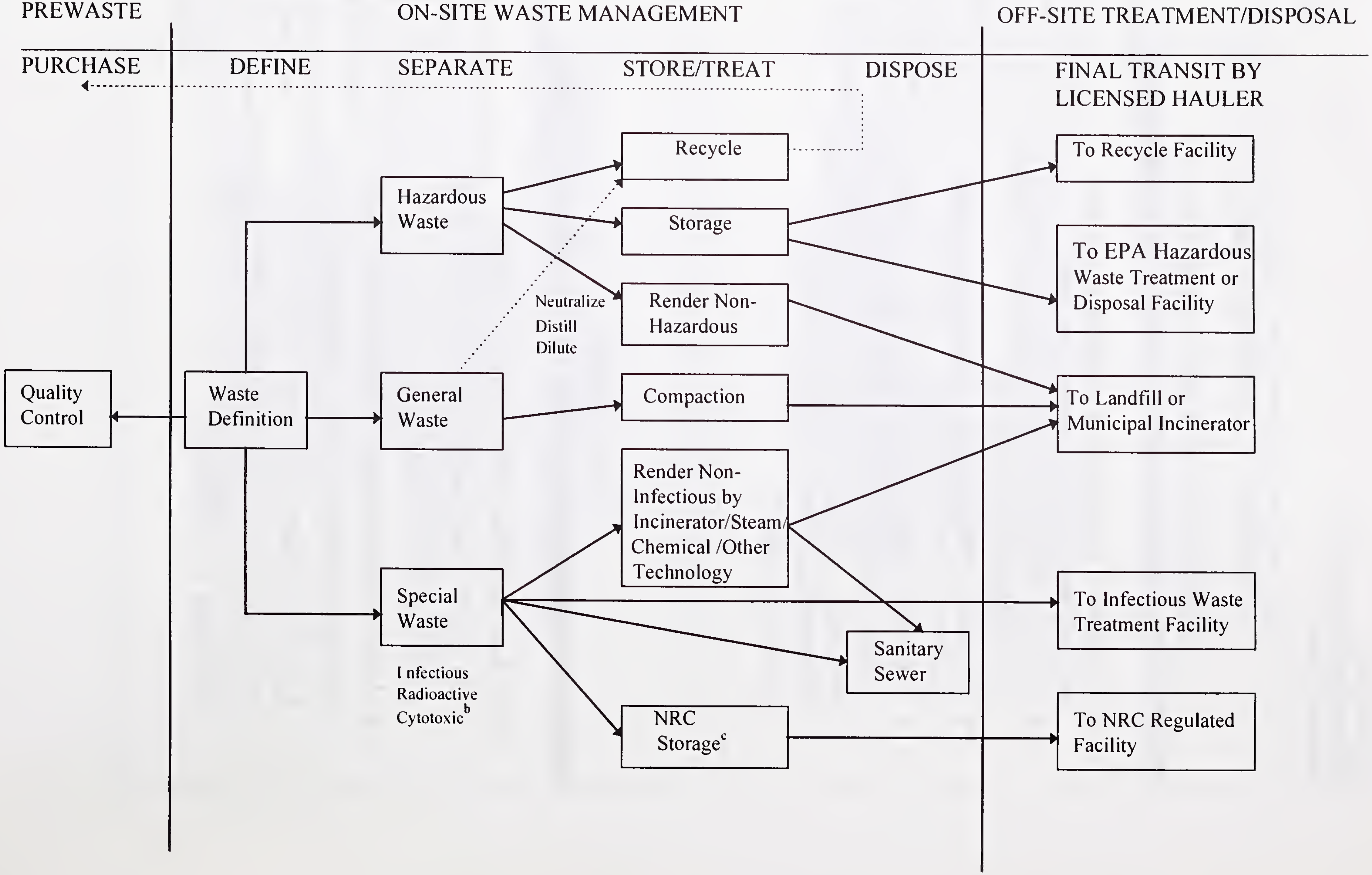
Figure 1. Medical Waste Management Planning and Implementation Process.[a]



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REGULATIONS	REGULATIONS	REGULATIONS
JCAHO, OSHA	Federal (EPA, NRC, OSHA), State, Local	Federal (EPA,NRC), State, Local

[a] Adapted from Denys, G.A., Infectious Waste Management. In: J. Lederberg, ed. Encyclopedia of Microbiology. Academic Press, Orlando, FL, 1992, 493-504.

[b] Some cytotoxic waste must be managed as hazardous waste.

[c] After decay in storage (DIS), waste can be disposed of as non-regulated waste.

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Table 1. Comparison of On-site Medical Waste Treatment Technologies.

	Traditional Methods		Alternative Treatment Methods[a]		
Factor	**Incineration**	**Steam/ Autoclave**	**Steam/ Mechanical[b]**	**Steam/ Compaction[c]**	**Steam/ Heat/Alkali[d]**
Type of Waste[e]	RMW/P/C	RMW	RMW/P	RMW	RMW/P/C
Equipment operation	Complex	Easy	Easy/automated	Easy/automated	Easy/automated
Operator requirement	Trained and certified	Trained	Trained	Trained	Trained
Load standardization	Needed [f]	Needed[f]	Needed [f]	Needed[f]	Needed
Capacity[g]	1,200 lb/h	200 lb/h	200-1,370 lb/h	25-2,000 lb/h	10-10,000 lb/h
Effect of waste treatment	Burned	Unchanged	Shredded/ground	Compacted	Digested
Volume reduction	85-95%	30%	85-90%	60-80%	98%
Potential side benefits	Energy recovery	None	Yes[h]	Yes[h]	Yes[h]
Disposal of residue					
Liquids	Treated[i]	Sanitary sewer[j]	Sanitary sewer[j]	Sanitary sewer[j]	Sanitary sewer[j]
Solids	Hazardous ash[k]	Sanitary landfill[l]	Sanitary landfill	Sanitary landfill	Sanitary landfill

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Factor	Alternative Treatment Methods[a] Chlorine Dioxide/ Mechanical[m]	Peracetic Acid/ Mechanical[n]	Radiation/ Mechanical[o]	Microwave/ Mechanical[p]	Pyrolysis/ Oxidation[q]
Type of waste[e]	RMW/P	RMW	RMW	RMW[r]	RMW/P/C
Equipment operation	Easy	Easy	Complex	Easy	Easy/automated
Operator requirement	Trained	Trained	Trained	Trained	Trained
Load standardization	Needed[f]	Needed[f]	Needed[f,s]	Needed[f,s]	Needed
Capacity[g]	600 lb/h	20 lb/h	n/a	550-900 lb/h	100-2,500 lb/h
Effect of waste treatment	Shredded	Pulverized	Shredded	Shredded	Vaporized
Volume reduction	85-95%	Up to 85%	Up to 85%	Up to 85%	99%
Potential side benefit	Yes[h]	Yes[h,t]	Yes[h]	Yes[h]	Energy recovery[h]
Disposal of residue					
Liquids	Sanitary sewer[j,u]	Sanitary sewer[j]	None[v]	None[v]	Sanitary sewer[j]
Solids	Sanitary landfill	Sanitary landfill	Sanitary landfill	Sanitary landfill	Sanitary landfill

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[a] Information provided by manufacturers.
[b] Tempico, Inc., Madisonville, LA.
[c] San-I-Pak , High Vacuum Autoclaves, Tracy, CA.
[d] Waste Reduction by Waste Reduction, Inc., Indianapolis, IN
[e] Infectious waste types; RMW = regulated medical waste, P = pathological waste, C = chemotherapeutic waste. Waste segregation may be needed to eliminate pathological, chemotherapeutic, and/or nontreatable waste from the wastestream.
[f] To eliminate bulk fluids such as dialysis fluid (greater than 10% by weight).
[g] Includes a range of models.
[h] No harmful by-products; lower volume to commercial wastestreams.
[i] If there is scrubber water present, it must be treated at POTW or on-site.
[j] Low volume or intermittent drain to sanitary sewer.
[k] RCRA-permitted landfill.
[l] Potential problem with recognizable red bag waste.
[m] World Environmental Services Co., Ramona, CA.

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[n] STERIS Corporation, Mentor, OH.
[o] Stericycle, Inc., Deerfield, IL.
[p] Sanitec, Inc., West Caldwell, NJ.
[q] Bio-Oxidation Services, Inc., Harrisburg, PA.
[r] Metallic content must be less than 1% by weight.
[s] To separate sharps from waste.
[t] Point of generation treatment.
[u] Potential formation of carcinogenic compounds in chlorine-based systems.
[v] Moisture retained in solids or held within the unit.

Adapted from Marsik, F.J. and Denys, G.A., Sterilization, decontamination, and disinfection procedures for the microbiology laboratory. In: Murray, T.R., Baron, E.J., Pfaller, M.A., Tenover, F.C., and Yolken, R.H., eds. Manual of Clinical Microbiology, 6th ed., American Society for Microbiology, Washington, D.C., 1994, 86-98.

References:

1. Freiberger, F.G. and D.B. Kohl. 1998. Managing Healthcare Facility Waste. FacilityCare. June/July Vol. 3, No. 6, pp 24-25.
2. Gordon, J.G. and G.A. Denys. 1996. Minimization of waste generation in medical laboratories. In Reinhardt, P.A., K.L. Leonard, and P.C. Ashbrook (ed), Pollution Prevention and Waste Minimization in Laboratories, pp. 163-193. Lewis Publishers, CRC Press.
3. Gordon, J.G, P.A. Reinhardt, G.A. Denys, and C.J. Alvarado. Medical Waste Management, In C.G. Mayhall (ed). Hospital Epidemiology and Infection Control, 2nd ed. In Press.
4. Willington, T. 1998. Complying with JCAHO's Hazardous Materials Standards. Facility Care August Vol. 3, No. 7, pp10-11.
5. Wenk, P.A. 1998. Q&A Disposal of Histologic Stains; Grant Proposals. Laboratory Medicine, June Vol. 29, No. 6, pp 337-338.

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Hazardous Waste Reduction in Surgical Pathology

Introduction

As regulations change and natural resources dwindle, it is important that health care providers have a proactive waste reduction plan[1]. The Surgical Pathology Department at the VA Medical Center, Albuquerque, New Mexico, incorporates several strategies in our waste reduction plan. Strategies may include: reducing, substituting, or recycling hazardous wastes.

Our waste reduction strategy starts by defining the procedures and chemicals involved in producing a product. A product may be defined as: fixing a specimen, producing a microscopic slide, or it may even include the disposal methods for hazardous wastes. Next, we determine if a component involved in the process may be reduced, substituted, or recycled. After a component has been identified, we review the item to determine if, by eliminating one problem, we are not creating additional hazardous waste or increasing our costs. For example, osmium tetroxide may be recycled. However, the byproducts of recycling osmium pose a greater problem of waste disposal, than a few grams of oxidized osmium. Likewise, a smaller specimen container may reduce the amount of fixative used. However, the type of material the container is composed of may have trace elements that could increase the costs associated with its disposal.

The most successful strategy to reduce hazardous wastes for us is to reduce the volume of a substance. We have found that this method has little or no adverse impact on patient care. Furthermore, reducing the volume of a reagent does not require specialized equipment.

Examples of Hazardous Waste Reduction:

Bouin's Fixative:

Initially, the Histology Laboratory was supplying several clinics with small containers filled with 20 ml of Bouin's fixative. In 1995, we examined our Bouin's usage, and started supplying the same clinics with smaller containers filled with only 5 ml of Bouin's, (Evergreen Scientific, 800-421-6261). We still maintained the optimum ratio of fixative to specimen, (10:1) and reduced our Bouin's usage by 4 liters per month.

In late 1997, we re-examined our Bouin's usage and determined that it could be eliminated as a routine fixative for gastrointestinal and genitourinary biopsies.

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Advantages (pre 1997)	*Disadvantages*
Reduced chemical usage and costs	None
Reduced chemical wastes	
Smaller containers cost less	
New containers require less storage space	
Reduced disposal cost for used containers, (less weight)	
Reduced employee's possible exposure to toxic chemicals	
Smaller containers did not leak	

Summary:

Old specimen containers	5.3 liters of Bouin's per month
New specimen containers	1.3 liters of Bouin's per month
1998 usage of Bouin's fixative	0.1 liter of Bouin's per month

Bouin's was also eliminated as a stabilizer for specimens that had inked surgical margins. We substituted 10% glacial acetic acid for Bouin's fixative. Household vinegar may also be used to stabilize the inked margins.

Mercury Fixatives:

The same principle of incorporating smaller specimen containers also worked for our B-5 mercury fixative. We reduced the volume of fixative from 50 milliliters per container to 15 milliliters per container.

Advantages:	*Disadvantages:*
Reduced chemical usage	None
Reduced chemical wastes	
Smaller containers cost less	
Smaller containers do not leak	
New containers require less storage space	
Less disposal cost for containers	
Reduced employee's possible exposure to toxic chemicals	

Summary:

Old specimen containers	500 milliliters per month .400 grams of $HgCl_2$ per year
New specimen containers	150 milliliters per month .119 grams of $HgCl_2$ per year

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Currently, we are performing side by side evaluations with B-5 fixative and zinc buffered formalin fixative.

Waste Water:

The Histology lab also eliminated a minimum of 39,000 gallons of potable water per year by installing a surplus refrigerated water recirculating unit on the xylene still. The xylene still was originally designed to use tap water to cool the condenser unit. This unit continuously circulates approximately 4 liters of chilled water through the still. As a side note, New Mexico's annual rainfall is 8 inches.

Advantages:	Disadvantages:
Eliminated potable water usage	None
Eliminated mineral build up in the condenser from tap water	

Paraffin:

We do not over fill the embedding molds/cassettes with paraffin when we embed specimens. We save approximately 24 gallons of paraffin per year. Furthermore, used paraffin from embedding units and tissue processors is recycled by adding used paraffin to specimen trays. This system is excellent for "pinning out" large specimens to facilitate fixation.

Advantages:	*Disadvantages:*
Reduced initial cost of paraffin and paraffin block storage units	None
Able to store more paraffin blocks per filing system	
Reduces disposal costs of paraffin blocks	

Special Stains:

We have reduced the volume of special stain reagents by reducing the size of the staining container, (Evergreen Scientific, 800-421-6261).

Advantages:	*Disadvantages:*
Reduced reagent volumes	Holds only 4 slides
Containers are disposable or re-usable	Not suited for microwave procedures, (shape)
Eliminated stain precipitation vs. flooding stain on slide	

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Examples of Substituting Chemicals:

To further reduce the use of mercury in the laboratory setting, we substituted 0.37 grams of sodium iodate for 2.5 grams of mercuric oxide per liter in the hematoxylin stain. This saves an additional 50 grams of mercury per year.

Advantages:	*Disadvantages:*
Mercury free hematoxylin stain performs better	None
Reduced chemical usage	
Reduced chemical wastes	
Reduced employee's possible exposure to toxic chemicals	

Special Stains:

We are currently using a Diff-Quik® Stain, (Allegiance Scientific Products, 800-9645227) for all GI biopsies, to rule out H. pylori bacteria. This stain has many advantages over a Giemsa stain and a Genta stain.

Diff-Quik®	Giemsa stain	Genta stain
Advantages:	*Advantages:*	*Advantages:*
Reduced chemical usage	Multiple colors	Multiple colors
Reduced chemical wastes		
One step stain 1 to 25 hr		
procedure 2 hours		
Staining time is 3 minutes		
Costs $0.43		
Disadvantages:	*Disadvantages:*	*Disadvantages:*
Monochrome	Cost $2.75	19 steps
		Costs $15.00
		Radioactive chemical
		Silver stain

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Examples of Recycling:

All xylene and xylene substitutes are recycled.
Activated charcoal used in the tissue processors may be recycled by autoclaving and reusing it. However, we do not recycle our used charcoal. We found that it was cost prohibitive to autoclave the charcoal.

Autopsy Suite:

We use a portable ultraviolet light system to complete the decontaminating process after autopsies. This unit also reduces the amount of cleaning solutions required after an autopsy. Furthermore, ultraviolet radiation is recommended by OSHA after an autopsy performed on patients with an active case of TB or other biohazards.

Advantages:	*Disadvantages:*
Portable unit decontaminates faster than wall mounted units	UV light hazard
Unit may be used in other areas, (Microbiology or in isolation rooms)	
Reduced the volume of cleaning solutions required after an autopsy	

Creutzfeldt-Jakobs Disease:

To fix and neutralize neurological tissue containing the Creutzfeldt-Jakobs virus, we use a combination of 20% formalin and 10% bleach. A solution of 20% Formalin and phenol will also neutralize the virus; however, phenol is lethal in high concentrations. Additionally, at our facility, phenol is classified as a hazardous waste and must be shipped off station.

Conclusion

Finally, difficulties in reducing hazardous wastes may be encountered as a facility attempts to balance the customer's needs with production of biological or chemical wastes. However, a proactive waste reduction plan allows a facility the time and resources to test, analyze, and evaluate new strategies to reduce their waste. Waste reduction may be as simple as reducing the volume of a reagent to the acquisition of specialized equipment. Annual review of procedures and chemicals may identify components that can be reduced, substituted, or recycled.
As new commercial products become available, additional hazardous reagents may be eliminated from the health care environment.

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References

[1] College of American Pathologist, 1997, "Standards, General Check List," Question: 01:7070 (Phase I). Health Care Providers are required to have a defined program to reduce hazardous wastes.

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Mercury Reduction in the Clinical Laboratory

Introduction

This presentation will emphasize reduction of mercury in a Clinical Laboratory setting, but could be implemented for any toxic material. To reduce use of any toxic material you first have to recognize that you have it. Once you identify the material or materials that you need to reduce or eliminate from your facility, you are really faced with three questions:

1) Where do I begin?
2) How do I interpret and utilize results of the investigative process?
3) How do I reduce or eliminate the material?

Newton-Wellesley Hospital began to look at sources of mercury in the laboratory in order to comply with its water discharge permit to the local Water Treatment Plant (Massachusetts Water Resource Authority). This paper will outline the process followed and present the results of our chemical testing and subsequent mercury-reduction activities.

Activities Performed at Newton-Wellesley Hospital to Identify Sources of the Mercury Contamination Problem

1. We identified all reagents used in the department. A database was established using MSDS information and the quantity discharged by the lab. The chemicals were then screened for mercury-containing substances.

2. We segregated waste by department and screened the waste for mercury. First we placed large drums for collection of all waste in all departments. The drums were used to eliminate the possibility of the pipeline as a source of mercury. Aliquots from the drums were tested for mercury. In retrospect the ideal situation would have been a laboratory that is plumbed to segregation of waste streams once plumbing is determined to have below quantitative levels of detectable mercury.

3. All laboratory waste streams which tested positive for mercury were then segregated by bench. Collection stations were placed on every bench and aliquots of those wastes were submitted for analysis. The bench areas from which the mercury-containing waste came were identified. The MSDS for reagents used on these benches were scrutinized, and the manufacturer was contacted for additional information. Suspect reagents were tested for mercury content.

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Laboratory Mercury Contamination: Results of Initial Testing

Laboratory	bench	analytical reports mg/L (Cert. Lab testing)
Chemistry	TDX benches	BQL limit =0.005
Chemistry	IMX benches	BQL limit =0.001
Chemistry	Array	BQL limit =0.002
Chemistry	Flex benches	BQL limit =0.005
Chemistry	E4A bench	BQL limit =0.002
Chemistry	Specials bench (Electrophoresis)	8.8
Chemistry	Plating soln.(leads)	0.6
Cytology	EOSIN stain	BQL limit =0.002
Cytology	OG-6 stain	BQL limit =0.005
Bacti	CSpor	10
Bacti	Hepatitis(Abbot)	0.15
Bacti	Probes	0.002
Bacti	Methylene blue	0.002
Bacti	Basic fuchsin	0.002
Bacti	Iodine	BQL
Bacti	Crystal violet	BQL
Bacti	Auramine-Rhodamine	BQL
Bacti	Parasitology (known to contain Hg)	25
Hematology	Coagulation (MLA + Dade Reagents)	BQL
Hematology	IRIS	BQL
Hematology	Technicon H1	BQL
Hematology	Hematoxylin	BQL
Hematology	Coulter T890	BQL
Hematology	Semen analysis (Hematoxylin)	0.04
Hematology	Naphthol and NAP AS-D	BQL

Hematology	LAP	BQL
Hematology	Acid Hemat. Soln.(Sigma) (Peroxidase Satin)	0.01
Hematology	Gill's Hemat.#3 (LAP Counterstain)	BQL
Histology	H&E.stainer	BQL
Histology	Floatation water baths (Microtome Stations)	Ranged from 0.008 to 1.18
Histology	VIP fixative	116
Histology	Composite sample	0.001
Histology	Tote waste	0.004
Histology	Water from VIP filter *	0.04
Histology	Processor 1*	8.0
Histology	Stainer rinse 2 *	0.016

Interpretation of Testing Results

Mercury is one of four substances strictly prohibited from sewer discharge. The accepted detection limit based on methods currently acceptable to the EPA is at 0.0002mg/L or 0.2ppb. The threshold for enforcement in Massachusetts (MWRA District) is 0.001mg/L or can also be expressed in micrograms as 1 ug/L or expressed in parts as 1 ppb (part per billion).

MSDS reportable limits: Since heavy metals are considered to be carcinogens or potential carcinogens the concentration limit set by OSHA for manufacturers to disclose their presence is set at 0.1%. this is equivalent to 0.1g/100ml or 0.01gm/L or 10mg/L. Most manufacturers outside of Massachusetts therefore feel that they have exceeded their responsibility by reporting the presence of mercury when it exceeds the EPA limit of 1 ppm or 1mg/L, as they legally only have to include it on the MSDS when it exceeds 10 mg/L. This is important to recognize when dealing with manufacturers.

In evaluating a product, we must establish if the product is certified mercury free or if the manufacturer has attempted to test only to the limit set nationally. A company may insist that the product does not contain mercury because the company did not detect its presence at a level of 10 ppm or 1 ppm or higher. It is therefore very critical to ensure that a product to be used in this hospital has been tested to detect mercury at levels at or below 1 ppb not 1ppm.

Below quantitative limits (BQL): This means that the results of the testing demonstrated that there was no mercury detected at the lowest concentration that the laboratory's method for testing for the concentration of mercury in that particular specimen could detect. When BQL is written you need to know what the limits of detection are for the analysis that you had performed.

BQL could be written by some laboratories as <2.00 ug/L with the detection limit stated to be 2.0 ug/L, thus stating that the laboratory analysis as run could not detect levels of mercury below 2.0 ug/L(ppm). When the term BQL is used the laboratory has to state the detection limit.

Reagents Testing Below Quantitative Levels of Measurement for Mercury

Hematology

Non-specific and Specific esterase Kits
LAP stain
Technicon H1 reagents - measured as a mixture
Coulter T890 reagents - measured as a mixture
IRIS reagents - measured as a mixture
Dade coagulation reagents - used with MLA

Cytology

OG-6
EA-50 mod
EASO stain

Blood Bank

Gamma N-Hance (LISS)
Baxter Certified Blood Bank Saline

Chemistry

Mixture of reagents and a waste sample collected from each of the following instruments and tested:
TDX
IMX
Flex
Array
Beckman E4A
CPK Iso

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Continued Testing and Discussion

Histology:

Embedded tissue that had been fixed in VIP or other known mercury containing compounds continued to leach mercury and contaminate other areas of the histology laboratory.

Water baths at microtome stations are the first solutions into which fixed tissues were placed for processing and staining. We should find alternatives for mercury containing stains.

Microbiology

Parasitology stains and preservative contain mercury; alternatives need to be found. Stains need to be tested and replacements for mercury-based reagents, PVA transport system and preservative need to be found.

Hematology

Few problems with mercury, stains and reagents not a problem.

Chemistry

Testing results from the follow-up of the 8.8 mg/l found in the electrophoresis waste:

Electrophoresis Reagents:
HGBA1C buffer = 0.028 mg/L
IFE buffer = 0.2 mg/L
Elec. Stain = 1.8 mg/Land IFE BQL
Could not account for the 8.8 mg/L detected

Further evaluation led us to the blood bank saline and blood bank.

Blood Bank Reagents:

Grand mix blood bank reagents	14.3 mg/L
Blood bank waste (plumbing sample)	5.8 mg/L
0.9% sterile saline bags	BQL
Dade certified blood bank saline	0.029 mg/L
Dade immusal (saline)	44.2 mg/L
Immu add (LISS)	0.206 mg/L

Alternative reagents tested:

Ortho antibody enhancement	0.07 mg/L

Gamma N-Hance	BQL limit (0.0005 mg/L)
BCA EM-X	0.138 mg/L
Grand mix (all reagents + H2O)	BQL limit (0.0005 mg/L)

Toxic Waste Management Program

The analysis and testing done as a result of the mercury problem led to the establishment of a Hospital Mercury Reduction Policy, a method for tracking and following progress of Mercury containing reagents, and establishment in the laboratory of a Waste Reduction Program.

Mercury Reduction Policy

Purpose: To enable the Hospital to meet mercury level standards established by the federal and state environmental protection agencies and the Massachusetts Water Resources Authority ("MWRA") and requirements of the Hospital's Sewer Use Discharge Permit.

Background: Mercury is a hazardous substance under state and federal environmental laws. The Hospital's Permit and MWRA regulations prohibit the discharge of mercury into the sanitary sewer system. Pursuant to its permit, the Hospital must monitor its discharges into the sewer system of several elements, including mercury. Among other enforcement actions, the MWRA may assess monetary penalties for discharges which exceed the standard. Neither government nor private agencies have been able to identify a process by which mercury can be successfully removed from a water stream. The Hospital, therefore, must attempt to prevent mercury from entering its waste water stream in order to protect public health and to avoid penalties.

Policy Statement: Mercury containing products and processes shall not be used in any manner on the Hospital campus, including within the Hospital buildings and medical office buildings, unless no reasonable alternatives, as determined by Hospital Administration, are available. When use of a mercury containing product is permitted, measures shall be taken to avoid introduction of mercury into the sanitary sewer system.

Applicability: Compliance with this policy and its procedures is a condition of employment and a condition of the exercise of clinical privileges or the use of any property located on the Hospital campus. The Hospital reserves its right to take any and all actions, including to seek injunctive relief, to prevent violation of this policy by any party.

Procedures:

I. The Hospital's Departments of Engineering, Environmental Services, Purchasing, Pathology, Radiology, and Safety shall work together to identify product(s) or process(es) containing mercury currently in use on the Hospital campus and to identify acceptable alternatives. A list of such products/processes and their alternatives shall be presented to the Safety Committee which shall arrange for its distribution throughout the Hospital community.

II. When mercury containing products or processes are identified, the manager(s) for the department(s) using such products/processes shall develop a plan to include a.) procedures for the prevention of disposal of any mercury into the sanitary sewer system, b.) a timeframe for the elimination of the use of these products/processes or, in the alternative, the rationale (including information required below at IV) for continued use of such products/processes. The manager(s) shall present the plan to the Safety Committee for review and approval.

III. The Safety Committee shall review all mercury use plans and may approve the plans as submitted or with modification.

IV. Managers of departments using mercury products/processes shall maintain a readily retrievable log of the mercury containing products/processes, the approved use(s), the alternatives considered, the reasons such alternatives were deemed unacceptable, and a time frame for reconsideration of available alternatives.

V. In the event of a mercury spill, employees and physicians shall follow the procedures of Safety Policy #28-8, Handling of Mercury Spills. Managers shall report such spills to the Safety Committee for review.

VI. All employees and physicians shall prevent the disposal of mercury into the sanitary sewer system and shall refrain from using mercury containing products/processes on the Hospital campus unless such use has been approved in accordance with this policy.

VII. All employees and physicians are encouraged to present suggestions for eliminating mercury containing products or processes from the Hospital campus to the Hospital Safety Committee.

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Newton, Massachusetts

FORM FOR TRACKING

PATHOLOGY LABORATORY
MERCURY CONTAINING COMPOUNDS

****

PRODUCT/REAGENT: ______________

LABORATORY: _____________________

MERCURY CONC.: ________ VOL. USED/WEEK _______

DISPOSAL PROCEDURE:

TIME LINE FOR ELIMINATION (INCLUDE ACTION TAKEN TO DATE TO ELIMINATE):

IF CANNOT ELIMINATE, RATIONALE FOR CONTINUING USE:

Anne Pollock
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Hazardous Waste Management Report, Pathology Department, January 1998

We continue our effort to comply with federal, state, and local hazardous waste requirements and to provide strong proactive leadership in hazardous waste reduction.

A major focus of the Pathology Department in 1997 was on the elimination of mercury and a reduction of toxic chemicals at the point of production. Our goal was to improve the workplace, help the environment and at the same time effectively cut chemical purchase and disposal costs.

Toxic use reduction was accomplished by:

1. Reduction in Chemical purchases and better inventory control, using the Meditech Chemical Database.
2. Purchase of equipment that utilized small reagent volumes and generated minimum hazardous waste.
3. Elimination of Hg PVA in Microbiology, replacing with a low Zn PVA system.
4. Replacement of manual staining procedures in Histology with kits continues with elimination of dry chemicals and toxic concentrated stains.
5. Increased employee training in hazardous materials management and mercury source reduction.

In January of 1997, training in hazardous waste management emphasized looking at chemical purchases with emphasis on actual need not restocking, cost of discarding expired reagents, and hazards of having a large inventory of chemicals. Chemical inventories were included as part of the monthly safety audit of each area and employee knowledge of chemical hazards were assessed during the routine safety inspections. As of January of this year the amount of hazardous chemicals we were expiring had decreased by half and safety inspection reports showed an increase in chemical safety knowledge.

Employee training in hazardous materials management and implementation of several chemical disaster drills in the department have heightened employee awareness of their role in handling spills and in controlling chemical waste. The disaster drill reports showed a marked improvement since 1996.

New instruments and procedures are now evaluated for the type and volume of chemicals used and for the impact they will have on our hazardous waste reduction policy. We have seen a reduction in flow volume of nonhazardous waste in the laboratory of 4500 gallons per month average last year to 4000 gallons per month this year. During the same time frame the laboratory has seen an increase in workload volume of as high as 21%.

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The total volume of hazardous waste drums generated per week showed no change from 1997, however, the workload volume in Histology alone showed a 23% increase. The fact that we were able to keep our hazardous waste volume at the same level even with an increase in testing volume was due mostly to the reduction in volume of reagents used, and a concerted effort by the employees in Histology to conserve and reduce toxic waste generated.

To comply with the Mercury Reduction Policy, all waste streams in Pathology continue to be tested for mercury; sources of mercury identified, and alternative products continue to be actively sought. As an active participant in the MASCO (Massachusetts Academic and Scientific Community Organization) Mercury Workgroup, we have taken a leadership role in developing protocols for toxic waste management, identifying effective pretreatment technologies, and ultimately reducing wastewater volumes.

The Pathology department is continuing to evaluate formaldehyde and xylene recycling systems. This would significantly reduce the hazardous waste volume sent out each week. We have looked at several excellent, small, safe, and cost effective systems in use in area hospitals. Space and personnel requirements are presently being evaluated by the department.

We continue to seek methods which will offer quality results with minimal chemical exposure and waste production. The ultimate goal is to utilize technology that eliminates employee exposures and toxic waste generation.

Addendum July 1998

Mercury testing in Microbiology revealed a mercury contamination of the sink and staining racks. The sink is on order and staining racks have arrived.

Measurement Units

Milligrams per kilogram or mg/kg equals mg/1000 g of the mixture. This is similar to mg/L as a measurement of a substance's concentration; however, mg/kg is not volume based but rather based on the specific gravity of the waste mixture. Expressing concentrations in these terms would eliminate the existing situation where concentration of mercury detected is dependent on the amount of diluent present. In other words, hospital A and hospital B may have the same amount of mercury discharge, but if hospital A has a much higher water usage and discharge than hospital B, hospital A's waste may be in compliance and hospital B's might not.

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Measurement Conversion Chart

Examples of the same concentration expressed in different volumes

Percent	g/100ml	mg/100ml	mg/L	ppm
3%	3g/100ml	3000mg/100ml	30000mg/L	30000 ppm
0.3%	0.3g/100ml	300mg/100ml	3000mg/L	3000 ppm
(not used)	(not used)	30 mg/100ml	300mg/L	300 ppm
(not used)	(not used)	3 mg/100ml	30mg/L	30 ppm
(not used)	(not used)	0.3 mg/100 ml	3 mg/L	3 ppm

mg/L	ug/L	ppm	ppb
3 mg/L	3000 ug/L	3 ppm	3000 ppb
0.3 mg/L	300 ug/L	0.3 ppm	300 ppb
0.03 mg/L	30 ug/L	0.03 ppm	30 ppb
0.003 mg/L	3 ug/L	(not used)	3 ppb
(not used)	0.3 ug/L	(not used)	0.3 ppb

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Mercury Thermometer Swap: The University Initiative

In January 1997, Environmental Safety Facility technicians became aware of a growing problem; an increase in the number of broken mercury thermometer spills on our campus. Not only was this potentially dangerous, but cleaning up the debris was time consuming, and the resulting disposal costs were expensive. Along with this increase in broken thermometers, the University had also been required by the EPA to have in place a chemical waste minimization program. Since it's opening in January 1994 as a TSD facility, we had seen an increase in chemical waste due to our efforts at cleaning up old chemicals left over in labs, in particular the chemistry building. Documenting that the University was actively engaged in reducing the amount of chemical waste became one of the goals of the ESF. Reducing the number of mercury thermometers on campus became one way to show initiative in that direction. The vehicle we chose for this project was UVM ChemSource, the chemical and safety equipment distribution program for the campus administered through the ESF.

Mercury as a Hazard

Mercury compounds have been used throughout history to chase away evil spirits, change base metals into gold, and as medicine. Of course, the usefulness of mercury is limited by its poisonous nature. As with most chemicals, there are two types of mercury poisoning, acute and chronic. Acute mercury poisoning results from the ingestion of soluble mercury salts, which corrode skin and mucous membranes. Mercury vapor aspirated into the lungs can cause severe pneumonia and death. Chronic mercury poisoning occurs through the regular absorption of small amounts of mercury. This condition is often a disease of workers in mercury mines, laboratories, and industries that use mercury. Organic mercury compounds, such as dimethyl mercury, are among the most dangerous.

Mercury vapors are colorless, odorless, tasteless, and toxic. When mercury thermometers break, lab and clean-up personnel are exposed to dangerous mercury fumes. An incomplete clean up creates the threat of long term exposure to mercury fumes. Furthermore, drops of the liquid metal can become lodged in floor cracks and behind equipment. Depending on the amount spilled and the air movement within the lab, the mercury vapor concentration in a lab with "hidden" mercury spills may exceed safe limits. A spill is more dangerous when mercury thermometers break in ovens or incubators because mercury evaporates readily at high temperatures, creating high mercury concentrations.

Disposal of mercury thermometers and the contaminated clean-up materials generated by a spill is very expensive. Materials containing mercury are currently disposed of at a cost upward to $100 per gallon. Thus, one 55-gallon drum of mercury waste shipped for disposal, could potentially cost the University $5,500. Spill debris uses much more space than an intact thermometer resulting in increased cost. Special clean-up procedures, such as dismantling an incubator or oven that has spilled mercury also increases costs substantially.

In the Beginning

Our initial search for replacement thermometers turned out to be a less than easy task. Most suppliers and vendors had very small selections of environmentally safe thermometers. The most common being the red alcohol thermometer, which we decided against mostly because the color did not meet our environmental perceptions. Fairly early we investigated a green spirit filled Enviro-Safe thermometer distributed by H-B Instrument Company. After several in-house tests and trial uses on campus, problems with column separation, thus accuracy, occurred, and we had to look further. We continued looking at various thermometer catalogs, trying to come up with a good selection of safe thermometers...our great wish being to get a good price. We had decided early on that the initial exchange would be funded through our operational budget. We turned to one of our campus scientific vendors, Krackeler Scientific (http://ksionline.com) to help us in our search. Eventually we decided upon a blue spirit Ever-Safe thermometer distributed by Ever Ready Thermometer Company (http://www.ertco.com) of West Paterson, New Jersey.

Learning of our project, the Chemistry Department immediately put in an order for replacement thermometers to be used by its undergraduate and graduate labs. We eventually stocked -20/110 deg. C (both total and partial immersion), as well as -10/260 deg. C, partial immersion thermometers...all in increments of 1.0 divisions. Choosing between a partial or total immersion thermometer created further problems.

Partial or Total Immersion?

Total immersion thermometers are designed to indicate temperatures correctly when the bulb and the entire liquid column are exposed to the temperature being measured. A partial immersion thermometer usually has a line or mark at the immersion distance from the bottom. It reads correctly when the bulb and the liquid column to that line are exposed to the temperature being measured and the emergent stem is at ambient or surrounding temperature.

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Step By Step

We needed to come up with an effective way to publicize the "swap." We hired a graphic artist to develop a flyer for us that would grab the attention of lab faculty and staff, not always the easiest task. It was amazing to see how much time it took to select an appropriate logo and colors. We eventually came up with a design we liked. Fortunately we had already gone through some of the details beforehand when UVM ChemSource first got underway.

By the Spring of 1997 we were ready to introduced our "Mercury Thermometer Swap." We sent a flyer to those individuals and departments that would most likely have significant numbers of mercury thermometers to exchange, one-for-one, and cost free. We also included several articles announcing the thermometer "swap" in Safety News, the University's chemical safety and health newsletter. As envisioned the initial cost would be covered by our operational budget, but we had no idea how many thermometers actually existed on campus. From the start we had envisioned a relatively small exchange, and were slightly overwhelm by the initial request by the Chemistry Department for over 800 thermometers. By March 1998, we had exchanged approximately 1,150 thermometers, with the bulk of them going to the Chemistry Department, and the remaining thermometers swapped or sold to other campus labs. Those investigators and labs that didn't have mercury thermometers to exchange could buy non-mercury thermometers from the ESF at greatly reduced cost. We instituted a 90-day return policy in which we stored the mercury thermometers at the facility until we received favorable, or no feedback concerning the use of the new thermometers, at which time we would declare the mercury a hazardous waste. We then sent a customer survey to the "swap" participants for their comments about the exchange. We eventually filled one 55-gallon barrel with these thermometers at a disposal cost of about $3,700.

More Precise, Sharing the Cost

We received several requests for specialized thermometer replacement; supplying these would cost far more than our budget could handle. We were able to get the help of the Chemistry Department to offset the increase in cost, with an agreement to share those costs over the next two fiscal years. In particular was the Chemistry Department's need for thermometers marked off in 0.1 divisions. Upon placing an order with ERTCO, we were told that the 0.1 divisions were no longer being made, and were being replaced with 0.2 division thermometers. We needed to know how accurate these were for laboratory needs. We talked directly with the technical sales advisor and were sent calibration certifications results to review. The .2 division thermometers performed well, but with some discrepancy experienced at the higher end of the temperature scale.

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Overview

In general our campus initiative to replace mercury thermometers with more environmentally safe thermometers was well received. This "short term" project became more complex then we initially thought. The program has added another dimension toward meeting our overall waste minimization objectives, while helping to bring about an increased awareness of the dangers involved with mercury. The campus has been given a non-mercury thermometer alternative to replace those "unloved" mercury thermometers, and has also helped reduce the University's overall clean-up and disposal costs. It is a small but hopefully model program for continued thermometer swaps.

Reference List

"We Want Your Mercury Thermometers Before They Break!" Safety News #49, Winter 1997, p. 7

"Mercury Thermometer Swap!" UVM ChemSource, February 1997

"Thermometer Exchange Underway." Safety News #50, Spring 1997, p. 8

"Mercury Thermometer Survey." UVM ChemSource, July 1997

"Mercury Thermometer Swap Continues!" Safety News #51, Fall 1997, p. 2

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Section 4: Dental Facilities

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Removal of Mercury from Dental Amalgam Wastewater

Abstract

Dentists, when either placing new or removing old "silver" fillings generate a considerable amount of waste amalgam. This may be in the form of chunks, small grindings, or slurry of fine grindings water. Most of this is vacuumed from the patients' mouths and eventually sent down the drain into the office wastewater.

Municipalities, including King County, have found that a significant percentage of mercury discharged to the sewer systems originates from dental office effluent. This amalgam wastewater exceeds King County sewer discharge limitations for mercury by three to four orders of magnitude.
Technological source control solutions do exist and are available to dental offices. However, there are concerns about the effectiveness, ease of use and cost of these devices. Overcoming these and other barriers is essential to creating new pollution prevention behaviors that keep dental mercury from the municipal waste streams and reroutes it to reclamation.

This paper evaluates these concerns from the viewpoint of both local government technical assistance providers and a practicing dentist. Practical aspects of choosing to remove and reclaim mercury as well as selecting and using these devices will be presented.

Devices available to dentists range in their effectiveness and cost. This paper evaluates methods of treating dental wastewater to separate amalgam particulate from the liquid fraction of the wastewater. The metals removal capacity of commercially available equipment from two manufacturers were investigated.

We also designed, built and demonstrated metals removal capacity of a simple, inexpensive settling system. In addition to technological issues, behavior change principles are being applied to outreach efforts. Data from this study are being used to help determine best management practices for dental amalgam wastewater.

All three pieces of equipment tested show one to four orders of magnitude decrease in mercury concentration and loading after treatment. Removal rates average 95-99% depending on equipment used. In the case of the commercial equipment, our data verifies manufacturer’s claims for removal rates of around 99%. For our own piece of equipment, we see that a simple, inexpensive settling chamber can achieve removal rates in the 90-95% range and retain that ability over an eight month testing period.

Some of the criteria for evaluating the suitability of a system include: effectiveness, simplicity of operation and design, level of handling of waste material required of office personnel, '"fail-safe" mechanisms designed to avoid accidental spillage, system for handling proper recycling of material, and cost. While not all barriers to preventing mercury pollution have been over come, we have begun to address major concerns. Systems are in place in King County for proper collecting, transporting and recycling the mercury waste. Mercury removal from amalgam wastewater is recommended before discharge to the King County Metro sewerage system. We are seeking voluntary compliance from the dental community.

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Introduction

In the past twenty-five years, sewer utility pretreatment programs have successfully addressed discharge from large generators, (significant industrial users -- SIUs), to the sewer system. These industries are regulated, permitted and monitored. Currently about 15% of the pollutants to the sewer can be attributed to the big generators. The remaining 85% is from households, small businesses (conditionally exempt small quantity generators CESQGs), and non-point sources, such as stormwater (Galvin, 1991). Programs, such as King County Local Hazardous Waste Management Program in Washington State, have been developed to address the household and small business hazardous wastestream. Like other pollution prevention and source control programs, our purpose is to assure reduction of hazardous materials going into the municipal wastestream, to reduce the hazardous materials discharged to the environment through landfills, and sewage effluent and biosolids. Whether biosolids go into land application, as in King County, or are incinerated, source control is necessary to prevent hazardous material from accumulating and dispersing through the soil, water or air.

This program works with many industry types to develop best management practices, provide on site consultations and assist businesses in reducing hazardous waste. In addition to the dental profession, some of these are print shops, photo processors, automotive repair, auto-body shops, dry cleaners, machine shops and marinas.

Why Dental Waste?

Why were we concerned with dentists? Initially, King County was required by Washington Department of Ecology to prioritize the elimination of occasional spikes in the concentration of mercury going to King County's two main treatment plants. Other considerations were the presence of metals, such as mercury and silver, in wastewater treatment byproducts, including biosolids for agricultural use and effluent for non-potable water reuse programs. Source control of contaminants -- preventing metals and other possible pollutants from entering the sanitary sewer system in the first place -- is a priority in US Environment Protection Agency, Washington Department of Ecology and King County policies (The federal Clean Water Act; Washington State Water Pollution Control Law; Washington State Hazardous Waste Reduction Act; King County Ordinance No. 11034).

Thermometers, barometers, switches, fluorescent tubes, mercury boilers, manufacture of mirrors, dental amalgams, latex paint, pesticides and the electrical and instrument industries are among the potential sources of mercury (The Merck Index, 1989). In the King County service area there were no permitted significant industrial users (SIUs) generating significant levels of mercury. Industrial laundries, which may use limited amounts of mercury as a biocide, are regulated through pretreatment permits. All permitted discharges are restricted to a mercury limit of .2 parts per million. Mercury as a biocide in paints has been largely phased out and a review of studies on potential household product contributions did not indicate significant sources of mercury from this sector (Galvin, 1991; Rourke, 1991; Dickey, 1990-91; Jenkins and Russell, 1990; and Gurnham et al., 1979). Of the remaining sources, dental offices appeared to be the most likely potential source of mercury in the publicly owned treatment works.

Of the several hazardous wastestreams discharged from dental offices, we have focused this paper on amalgam wastewater, and, in particular, mercury. Although the other metals are of concern, mercury is present in the highest concentrations, is most toxic and has the lowest discharge limits (in King County).

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Mercury Cycle In Dentistry

How does mercury from dental amalgam actually get into the environment? The dental industry consumes perhaps 100T of Hg annually, though that figure is diminishing. It's made into amalgam in the dental office. Then a number of things can happen that lead to it entering the environment [Figure 1]. Excess mixed amalgam that is not actually used in a filling or is carved away *should* be saved and recycled by the dentist. Some, perhaps, ignore this, and it ends up in the trash and eventually a landfill or incinerator. Hopefully that doesn't happen very often. Extracted teeth with amalgam fillings in them end up in trash or medical waste - again, landfill or incineration. Crematoria have been shown to produce a significant amount of mercury vapor from incinerated remains. But the most significant avenue that we're talking about at this conference happens when amalgam fillings are placed or removed and particles, chunks, dust, or slurry get vacuumed up by the chairside dental vacuum system. Bigger chunks are caught in a chairside trap, and presumably this trap gets periodically cleaned out and the pieces saved and later recycled. Any of you who are dentists know, however, that the dental staff often may take the easy way and simply throw this in the trash or wash it out in the sink - down the drain. Most of what is vacuumed up is in smaller particles or slurry, which passes right through the chairside traps and heads for the office wastestream. This is the part we're particularly interested in today. How much is it, really, and how can it be stopped?

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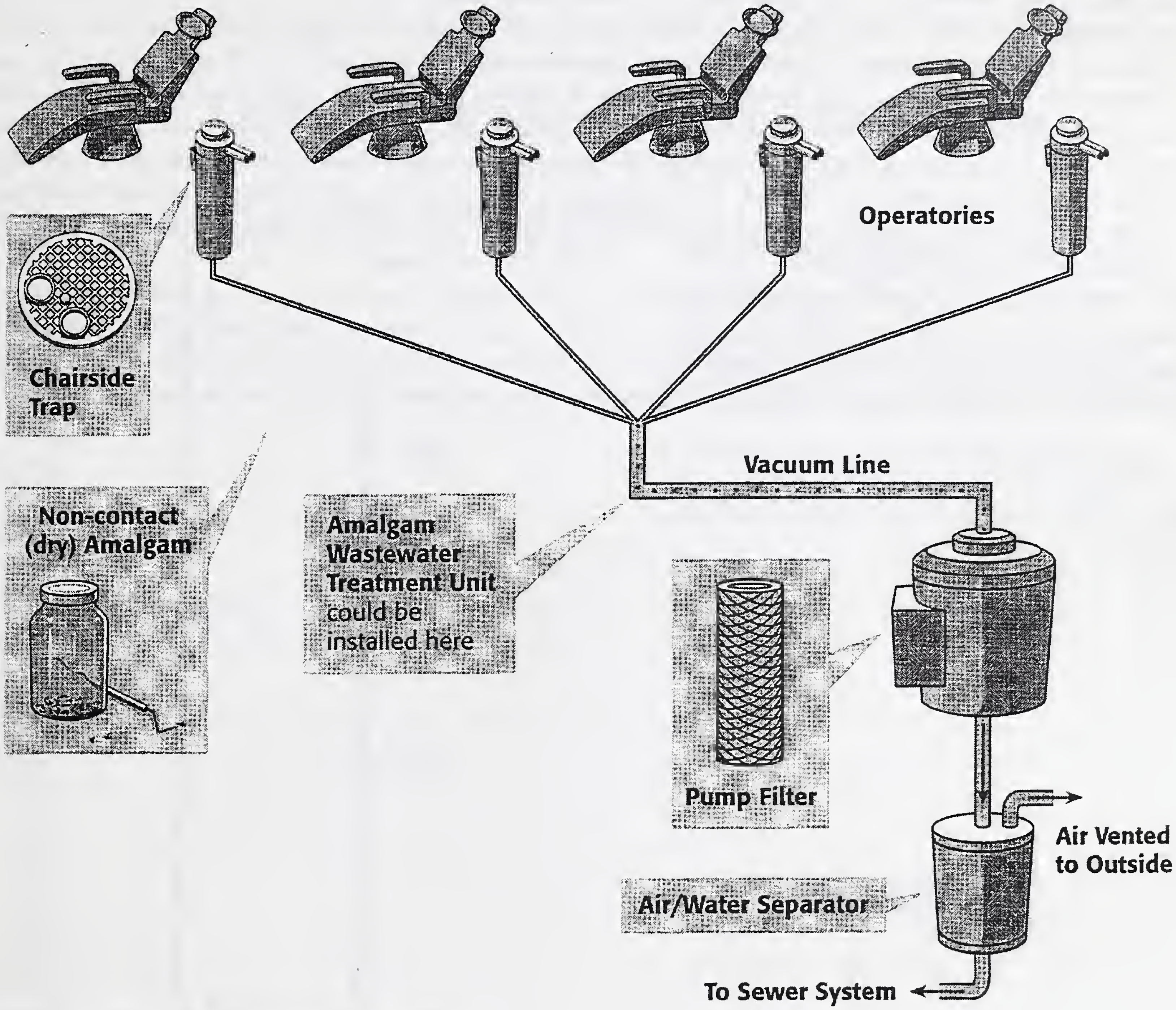

Figure 1. Dental Amalgam Wastestream Schematic

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HOW MUCH MERCURY?

In 1990, when we began this project, very little was known about dental waste. To appropriately address this waste, we needed to quantify and characterize it. We sampled the wastewater leaving the dental chair, and surveyed dentists to help determine quantities and types of wastes. Dental amalgam is made up of about 40-50% mercury, 25% silver and the rest is copper, zinc and tin. The results of sampling and surveying showed mercury concentrations of 100 – 2000 mg/L. The two long lines on the left side of the graph show the mean and standard deviation of mercury in untreated wastewater from dental operatories. [Figure 2.] This exceeds our 0.2 mg/L local mercury limit by 500 to 10,000 times. The portion of the mercury to the King County sewerage system from dentists was conservatively calculated at about 14% or 52 pounds per year. (Welland, 1991)

Other sewer districts have done similar studies. Minneapolis St. Paul found that an even greater proportion of mercury to the treatment plants, 76-80%, is from dentists. (Berglund, 1998). Differences in these results may stem from such factors as other sources of mercury, slightly different sampling methods, variability of samples, analytical difficulties and quite conservative assumptions on our part.

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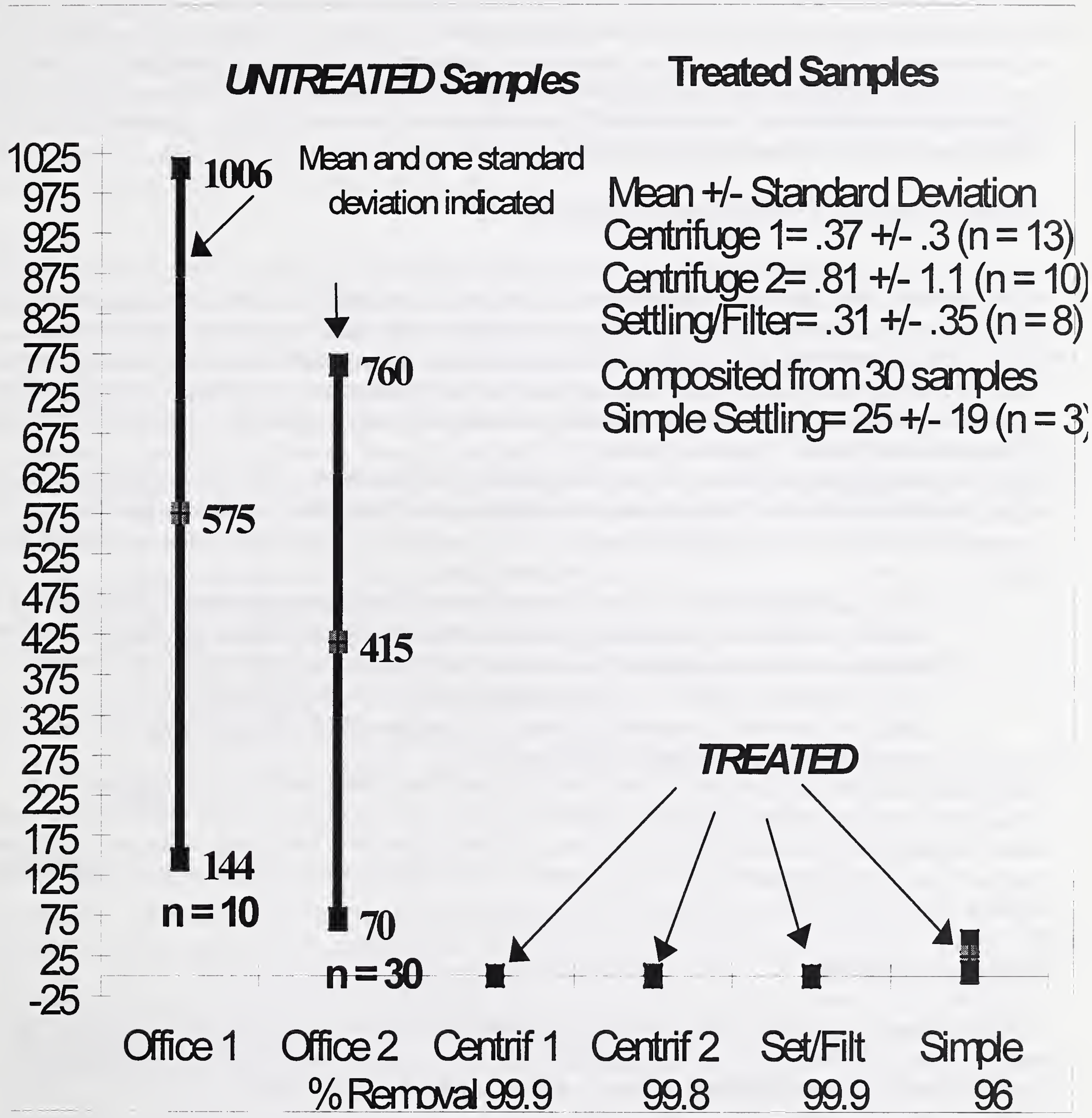
Figure 2
Mercury in Dental Wastewater
Loading to Sewer in mg/day



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APPROACH

Cooperation

From the beginning of this project we have worked with the local dental community. In 1990, we established an advisory board to explore dental waste issues and to help with a characterization study. We have continued with many joint meetings, waste management articles in the dental journal, talks and paper co-presented and joint development of best management practices (BMPs). Cooperation on waste management issues and outreach have been key.

Voluntary Compliance versus Formal Rulemaking

A local Hazardous Waste Disposal Rule for Dentists was proposed in October 1994. This rule would have required all area dentists who discharge to the King County POTW to install amalgam wastewater pretreatment units. During the public comment period the local dental community articulated their concern about further regulation of dental office waste disposal practices, citing such issues as costs, newly developing products and services, and unsubstantiated environmental damage. In addition, the local dental community expressed a willingness to work voluntarily toward reduction of their contribution of hazardous substances to the waste stream.

Instead of promulgating a rule for dentists, King County developed a program for working cooperatively with the dental community. King County has three long-term goals for compliance, based on the expectation that this voluntary approach continues to be embraced by the local dental community and our agency.

- First, institutionalization of waste management and reduction techniques in all dental practices, including reclamation of mercury and silver resources from amalgam wastes and x-ray fixer.
- Second, the inclusion of information about dental waste management and reduction in all formal training programs for dental professionals in this geographic area.
- Third, to document a measurable decrease in the amount of metals discharged to the sewer system from dental offices in King County.

King County and the Seattle-King County Dental Society have established an open, responsive and reasonable working relationship that has contributed to the success thus far of this voluntary approach to waste management by dental offices in our area. Although interest is increasing, voluntary compliance has been slow. Approximately 1% of King County's 1500 dentists have installed amalgam separation devices.

Overcoming Obstacles

We have encountered many obstacles or barriers while moving toward better management of wastes from dental offices. We have also seen a tremendous increase in interest and solutions to difficult issues. Issues include perception of problem, costs, technology and service availability.

Acknowledging there is problem depends on having reliable information about the waste and about regulations. It also depends on being ready to address the problem areas. Characterizing dental waste showed both agencies and dentists how much mercury is in dental amalgam wastewater. Although philosophical approaches to protection of the environment vary, and questions have been posed about what environmental damage is being done, a great many dentists are concerned about our environment and about doing what's right. The realization is growing that region by region, sector by sector, everyone is being called on to eliminate or reduce hazardous wastes. It is this attitude, that we all have a part to play, and the desire to be part of the solution, that overcomes the perception, common to every regulated business, of being over regulated, of being picked upon. Although some dentists may personally have no problem discharging amalgam waste, many are recognizing the problem and want to individually, and as a profession, demonstrate a pro-active response.

Responsible hazardous waste management is being noticed. A King County recognition program, EnviroStars, provides recognition to businesses for their efforts to protect the environment. Currently, 36 dentists have been recognized as EnviroStars. In addition, Dr. Rubin has received a Washington State Governor's Award, the first dentist to ever do so.

Costs

Complaints about cost of proper disposal are frequent since incorrect disposal of waste to the sewer may have no initial direct cost to the discharger. Proper disposal may cost more up front, but reduces liability and, as we all become more aware of total cost accounting, we realize the future costs of today's behavior. Pollution prevention is based on a hierarchy of eliminating, reducing, reusing or recycling wastes. Preventing pollution is very cost effective. The next step is source control. Once a pollutant has been generated, controlling it as close to its source as possible is generally the most effective and cost effective way of managing it. Once we accept that proper waste management and disposal are necessary, the task is to make it as convenient and cost effective as possible. Our program has taken a multi level approach to help dentists control costs. We:

- evaluated existing amalgam separation technology,
- developed inexpensive, effective technology,
- encourage the development of more technological options,
- stimulate the vendors to provide convenient waste management services at a realistic cost,
- provide information and free onsite consultations,
- modify regulations to provide more flexibility, and
- provide incentives – vouchers up 50% or $500 for services or equipment, to reduce hazardous waste.

Technology

To evaluate methods of separating amalgam particulate from liquid wastewater, King County tested the mercury removal capacity of two commercially available separator units and one easily fabricated settling unit. The tests were performed in dental offices. Manufacturers' claims of 99 + percent removal during standard testing were compared to results obtained in operating dental offices under local conditions. Testing was conducted for filtration, settling, filtration and settling, and centrifugation amalgam wastewater treatment equipment. The goal of testing the amalgam wastewater treatment units was to find out if treated amalgam wastewater met King County's local sewer discharge limit of 0.2 milligrams per liter total mercury. All operatories in this study used vacuum-suction only rather than cuspidor systems, reflecting the practice of the majority of dental offices in this region.

Results from the three amalgam wastewater treatment units are shown in Figure 2. The four points on the right side of the graph represent treated wastewater and show remarkable removal rates. All values are expressed in mercury loading (milligrams mercury per day). The loading figures show the weight of mercury discharged per day, independent of water dilution, disinfectants or any other materials. The three tested units are shown on the graph as follows: mechanical centrifuge (centrif 1 and centrif 2), settling/filtration unit (set/filt) and a simple, fabricated gravity-settling unit (simple) designed by a King County chemist and a process engineer – see Appendix 6). The graph shows one to four orders of magnitude reduction in mercury after treatment of amalgam wastewater.

Significant reductions of mercury in the sewer discharged waste stream of dentists are achievable. The commercial equipment reduced mercury by 99.9%. Even very basic treatment, such as that provided by the "homemade" King County model (less than $100 per unit), removed at least 95 percent of the mercury from rinse waters. While high levels of reduction are feasible with treatment, it was not demonstrated that 0.2 ppm mercury could be consistently achieved with the equipment tested. Chemical treatment in addition to physical amalgam removal did produce wastewater with a mercury concentration of less than 0.2 ppm. (Tomchick, 1998)

Demonstration Testing for Vendors of Amalgam Wastewater Treatment Units

Dentists requested some sort of treatment equipment "approval" by King County to assist them in assessing amalgam wastewater treatment units. While King County does not recommend specific equipment, a testing protocol was developed in 1995 to demonstrate whether a system consistently removes at least 90 percent of mercury under typical conditions that include, but were not limited to the standard practice use of in-line amalgam screens and traps. Demonstrations included installing the unit in representative dental offices. Requirements for the sampling report also included the vacuum drop associated with the amalgam wastewater treatment unit - stated both objectively (inches of Hg via gauge) and subjectively by dental office personnel. In addition, the reclamation or disposal of collected sludge and the method of infection control had to be explained. Finally, a description of the attention required by the vendor or dentist for proper operation and maintenance of the unit had to be provided [see appendices 3 and 4.]

Service

A major gap in the amalgam management issue was the question of reclamation. In 1990, the county had only one hazardous waste drop-off option that was available once a month for a fee of about $30 per gallon. It requires self-transportation, and has only one location. The material was handled as hazardous waste, and not reclaimed. Reclamation of amalgam slurry required more preparation than solid amalgam particles. Shipping to distant reclaimers had limitations as well. Also dentists really wanted a pick-up service, preferably of all wastes -- hazardous and bio-medical. Currently there are more services available, several mail-in services for solid amalgam exist, one pick-up service, and amalgam separator companies usually provide reclamation service as well. In a further effort to stimulate the local market and initiate new waste management habits of dental clinics, King County and the local dental society are sponsoring a dental waste pickup project which must include amalgam waste. Vendors are encouraged to provide pick-up for multiple waste streams and dentists are encouraged to use these services regularly. The county pays for the first pick-up. Three vendors have expressed interest, and the dental society will do the promotion and register dentists. King County will collect follow up information about the effectiveness of the project.

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What Makes A Good System?

Let's look at this diagram again [Figure 1]. It looks like it ought to be fairly simple to trap this stuff. Well, it is and it isn't. You can't just stuff some kind of filter in the line somewhere and have it work successfully. I'd like to point out some of the difficulties. Although there's not a lot of volume of water flowing through, it is flowing at a high rate of speed and force, mixed with large quantities of air. The speed and force are such that a simple filter is not likely to capture very much. Or, if the filter were dense enough to trap the sludge material, it would reduce the suction power so much at the chairside that it would be unacceptable. Besides the technical difficulties in designing an effective system, there are also behavioral factors. Since dentists are not yet very sold on this problem or highly motivated to make changes, anything that interferes with their routine or diminishes the effective use of their existing equipment will meet strong resistance. Most designs now incorporate some means of slowing down the flow to a trickle that can be effectively filtered, without diminishing the suction power. This is usually accomplished with some type of air/water separator tank. The vacuum pump is allowed to pull at the same force. The liquid portion of the evacuant drops into a holding tank or container where it can then drain or settle through a filter. The air whooshing through the line is vented to the outside of the building. This is required by code in any newer offices. It should be pointed out that this air contains a significant amount of mercury vapor, as demonstrated in a paper published a couple of years ago (Rubin, 1996, see appendix 2). That's a whole other issue, and we're not addressing that in today's presentation. At this point, most designs incorporate a filtration or settling process, or a combination. A couple of companies have tried using a centrifuge design to separate the heavier metals from the liquid. Here is an example of one system that uses air/water separation and a filtration system. There are a lot of companies who have put a lot of effort into designing systems that will do the trick. Having seen most of them, tested several of them in my own office, and worked with these systems for the last eight or nine years, I have learned a lot about what works, what doesn't and why. I'd like to list for you what I feel are essential elements of an ideal mercury capturing system for a dental office or clinic.

1. The system should be **effective**. That's the whole point of this. It should be able to prove that it can remove 90-99% of all the mercury, regardless of particle sizes in the amalgam sludge. At least two municipalities, King County in Washington State, and Minneapolis have tested several companies who have been willing to put their products through some testing protocols. It *does* matter how the testing is done. These two municipalities have done a great job, and I think their results should be looked at more closely than what the manufacturers' claim.

2. There should be **no compromise in suction power.** If you just cram some kind of dense filter inline with the vacuum pump, the effectiveness of the vacuum at chairside is going to drop, as I have mentioned. Again, this would be an unacceptable compromise.

3. **"Hands-Off"** feature. If this material is toxic and nasty (which it is), it's not a good idea to have a system where the dentist or staff has to frequently empty containers, decant off liquids, or handle or change filters. Ideally a system just sits there and does its job without much fuss or handling by the staff. Again, if it's difficult, the staff eventually won't do it, unless they are highly motivated. Then there will be a system supposedly in place that's really not functioning at all.

4. **Recycling.** It's not enough to capture this stuff - it needs to be recycled in order to get it out of the loop and keep it out of the environment. The handling of the recycling is not simple, but it's not quite

as impossible as it was a couple of years ago. The dentist needs to know how to prepare, package and send the collected material to a certified recycler and refiner of mercury. Who will take this stuff? How can it be shipped? Who is liable for it once it leaves the office? Can liability fall back on the dentist if there's a problem of improper handling somewhere down the road? Past case history indicates that's possible. It's difficult, but not impossible, for the dentist to find a way to handle this. It's much easier if the company that sold the unit also handles the recycling end of it. Some of the companies offer this service, and I'd recommend sticking with a company or dealer that does include doing this for you, with all the proper regulations and paper trail of liability adhered to. If a company just wants to sell you a system and leave you on your own to figure out recycling, I don't think that's a very good service. How often the collecting and recycling is done will depend on the design of the system.

5. **Simplicity** of design is a plus. The fewer moving parts and bells and whistles, the fewer things that can go wrong. Easy installation and easy maintenance means fewer problems and lower costs.

6. **Quiet operation** is a nice feature, though these units are usually installed far away from where staff or patients are.

7. There should be a **"Fail-Safe"** mechanism. What would happen if something clogged the line, or the filter got full too soon, or something like that. Are you going to have a toxic spill on your hands? Could it end up shutting down your vacuum pump? Some effective type of bypass design should be able to automatically handle these eventualities. These units are usually installed in an out of the way location, not often checked or seen by the office staff.

8. The unit should **install centrally**. Looking back at the office diagram,[Figure 1.] if there are filters set at chairside in each treatment room, they can capture all the new amalgam sludge. But all these connecting lines, all the way to the vacuum pump, are caked with years of buildup of amalgam sludge, prophy paste, saliva and crud, like arteries clogged with arteriosclerosis. Clean water passing through these lines is going to continue to pick up mercury and pass it along into the waste stream. This has already been demonstrated (Rubin, 1996). If you install a unit centrally, at the site of the vacuum pump, it will effectively clean the whole wastestream before dumping into the sewer system.

9. **Reasonable cost** is always important. Realize that you'll be paying for a system as well as for some means of periodic recycling. It's a good idea to compare companies on the *total cost* of having a system over a five or ten-year period, in order to really see how much it will cost.

We have prepared handouts that outline these features (appendix 1), as well as a list of some known manufacturers who have demonstrated a passable level of effectiveness with testing protocols through King County Industrial Waste Division (appendix 5).

Summary

Acknowledging that mercury discharge from dental offices is significant is an important first step to properly managing dental waste. Technological, logistical, financial and emotional concerns have been, and continue to be addressed by both the county and dentists. We have developed some solutions and BMPs cooperatively, and continue to get information to those who need it. The government may be able to provide information and education, possibly incentives and recognition. But it is you, the dentist, who

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can make the real difference. We encourage dentists, and any dental societies or organizations, to take the opportunity to act proactively on this matter, helping to protect the environment and gaining some good community relations at the same time. One professional organization, the International Academy of Oral Medicine and Toxicology (also called IAOMT) has taken as stand. Through its Standards of Care committee, it has recommended that all its members who are practicing dentists install proper mercury recapturing systems now. This is an excellent opportunity for individual dentists, and for dental organizations to lead the way to a cleaner, healthier environment.

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References and Bibliography:

Bergland, P. “Quantification of Mercury Discharges to the Wastewater Treatment Plant”. WEF Monologue: Controlling Dental Facility Discharges in Wastewater. In pre-publication, 1998.

Dickey, P.
    1) Database of safer substitutes for household hazardous products : phase one report / by Philip Dickey. Seattle, WA. : Municipality of Metropolitan Seattle, 1990.
    2) Database of safer substitutes for household hazardous products : phase two report / by Philip Dickey. Seattle, WA. : Municipality of Metropolitan Seattle, 1991

Galvin, D.V. *Why household hazardous waste management is needed.* p. 51—58 from the Proceedings of the Sixth National US EPA conference on household hazardous waste management (December 3-7, 1991). Publisher info: Andover, MA. : Dana Duxbury & Associates

Gurham, F.C. et al 1979. *Control of heavy metal content of municipal wastewater sludges.* Washington, DC : National Science Foundation.

Jenkins, D. "The contribution of heavy metals to wastewaters from household cleaning products" Report by Reed Corporation for the Soap and Detergents Association, July 1990.

Local Hazardous Waste Management Program (1993) Waste Management Guidelines for King County Dental Offices. Municipality of Metropolitan Seattle, Seattle, WA.

Daniel P. Rourke. *City and county of San Francisco consumer products heavy metals inventory* p. 301-305 from the Proceedings of the Sixth National US EPA conference on household hazardous waste management (December 3-7, 1991). Publisher info: Andover, MA. : Dana Duxbury & Associates.

Rubin, P. and Ming-Ho, Y. “Mercury Vapor in Amalgam Waste Discharged from Dental Office Vacuum Units” Archives of Environmental Health, vol. 51 No. 4, July/August 1996.

Savina, G. (1995) Dental Waste Education and Outreach, Project Work Plan. Hazardous Waste Management Program, Municipality of Metropolitan Seattle, Seattle, WA

The Merck Index. (1989). 11th Ed., Merck & Co., Inc., Rahway NJ.

Tomchick, L., C. Balogh and G. Savina. Planning and Implementing a Source Control Program.” WEF Monologue: Controlling Dental Facility Discharges in Wastewater. In pre-publication, 1998.

Water Pollution Control Department (1995) Demonstration Testing of Amalgam Wastewater Treatment Units. Municipality of Metropolitan Seattle, Seattle, WA.

Water Pollution Control Department (1994), Dental Office Project: Testing Treatment Technologies for Amalgam Rinsewaters. Metro Hazardous Waste Management Section, Municipality of Metropolitan Seattle, Seattle, WA.

Welland, C. (1991). Dental Office Waste Stream Characterization Study. Municipality of Metropolitan Seattle, Seattle, WA.,

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APPENDICES:

Appendix 1. ELEMENTS OF AN IDEAL MERCURY RECOVERY SYSTEM

1. **Effective** - 90-99%
2. **No compromise in suction power**
3. **"Hands-Off" operation**
4. **Recycling** provided by vendor as part of service
5. **Simplicity of design** - easy installation and maintenance
6. **Quiet operation**
7. **"Fail-Safe" mechanism** to prevent blockage, leakage, etc.
8. **Central installation** rather than at chairside
9. **Reasonable cost** - look at total cost, including periodic recycling cost

We recommend that you ask questions of prospective vendors until you are satisfied. If possible, try to talk with some existing customers as references.

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Appendix 2.

Mercury Vapor in Amalgam Waste Discharged from Dental Office Vacuum Units

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ABSTRACT. Clinical procedures in dental offices generate quantities of waste slurry or fine particulate matter, much of which is derived from dental amalgam filling material. This mercury-containing material is discharged into waste streams via the dental office vacuum pump system. This system also discharges large quantities of air, either into the atmosphere exterior to the office building or into the sewer system, depending on the type of equipment used. The purpose of this study was to investigate whether the discharged air contained mercury vapor.

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DENTAL AMALGAM RESTORATIONS ("silver fillings") have been the most widely used fillings for more than 160 y. These fillings contain approximately 50% mercury (Hg).' Elemental Hg vapor has been shown to escape from these fillings in the mouth.1-9 Skare and Engqvist10 reported recently that the number of amalgam surfaces was related to the emission rate of Hg into the oral cavity and to the excretion rate of Hg in urine.

Some amalgam "scrap" is generated in dental offices when amalgam fillings are placed or removed. The scrap is typically composed of small chunks of amalgam material, a slurry of grindings of extremely small particles, water, and saliva. The scrap is removed from the patient's mouth with a chairside suction or vacuum device that is powered by a vacuum pump located in a more remote part of the office or building. A mixture of the amalgam waste, containing Hg, water, saliva, and other debris, travels through pipes and tubing to the vacuum pump, where it is eventually discharged into the waste-water line that leads to the municipal sewage system. In some offices, the air and liquid portions of the evacuant are separated in an air/water separator tank. The liquid and solid materials are drained into the waste water while the air is vented elsewhere, usually to the outside of the building. Questions have been raised about the ultimate fate of this amalgam slurry and the possible environmental impact of its contents, particularly Hg."

If Hg vapor can be released from the amalgam in the human mouth, it is also possible that the vapor could be released from the amalgam scrap. Little information is available about such a possibility. We, therefore, studied air samples collected from eight sites at which air is discharged externally from the dental office vacuum systems.

Material and Method

A total of eight sites were selected within and around the city of Seattle, Washington, for this study.

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The sites were numbered randomly from one to eight. Some of the dental offices were occupied by a single dentist, whereas others were located in buildings in which a central vacuum pump served several dentists' offices. Some vents were located on the tops of buildings, and others were housed a few feet above ground level. Site five had a vent located approximately 1.5 m from the ground in an alley, and it was proximal to car and foot traffic.

A one-time "spot" air sample was taken at each of the discharge vents, and the concentration of Hg was determined three times during a 1 - to 2-min period. in addition, Hg release during an entire day was studied at site one; air samples were taken periodically at 30-min intervals from 7 A.M. to 5 P.M.

Concentrations of Hg were determined with a Jerome 431 -X mercury vapor analyzer (Arizona Instrument Company [Phoenix, Arizona]). This instrument was designed for the accurate analysis of Hg vapor in the workplace environment, for locating Hg spills, and for studies of intra-oral Hg vapor levels. In the presence of Hg vapor, a thin gold film undergoes an increase in electrical resistance proportional to the mass of Hg in the sample. Sample air is filtered to remove any acidic gases that might interfere with the sensor's response to Hg. The features of the analyzer are the following: range = 0-0.999 mg Hg/ml, resolution = 0.001 mg/m3, and accuracy = ± 5%. Air is drawn into the analyzer for 12 s at a flow rate of 750 cc/min. The instrument was calibrated for us by the manufacturer, and it was sent directly to us immediately prior to this study.

We did not conduct any direct measurements of air volume discharged at these sample sites, but we obtained the manufacturer's specifications regarding volume flow for the different types of vacuum units. This information was used to estimate the total daily discharge of Hg, based on the determinations of the Hg vapor concentrations.

Discussion

Spot-sample determinations and results of the 17 samples collected during an entire day at site one were similar (i.e., 0.103 versus average of 0.094 mg/m3, respectively [Table 1, Fig. 11). The "spot" sample appeared to be a valuable indicator of an individual office's Hg discharge level.

The levels of Hg vapor were higher in older dental offices, compared with newer facilities. Relatively high levels of Hg were detected at older office sites, even when no patient was being treated at the time of measurement. This suggested that Hg vapor was being released from amalgam residues that existed somewhere in the office plumbing. In one office, a piece of plumbing no longer in use (i.e., an old separating tank) released 0.332 mg/ml Hg vapor, thus implying that Hg vapor could be released from the static residue of amalgam sludge. A simple turbulence of air and water over existing amalgam slurry also seemed sufficient to cause release of Hg vapor. The environmental or health risks of this level of emission is not known. For purposes of comparison, the Occupational Safety and Health Administration (OSHA) cites an 8-h time-weighted average (TWA) Hg exposure limit for humans in the workplace at 0.050 mg/m3, The OSHA also has an ,acceptable source impact level" of 0.2 pg/ml for nonalkyl Hg vapor.

Perhaps the total quantity of Hg released in a given period of time is relevant. We could not measure outflow volume of air directly at the test sites. A rough estimate could be made, based on manufacturer's specifications. For the types and brands of vacuum pumps seen in this study, we estimated a flow rate of 0.5 to more than 5.0 ml/min. An attempt was made to correlate this information with the test data, making some assumptions on the running time of the pumps per day (they typically run continuously all day), per year, per dentist, etc. The total quantity of Hg released per day per dentist in these test offices was estimated to be 60 mg. Extrapolation of that result to 112 000 U.S. dentists," who work at least 200 d each year, led us to conclude that the total quantity of Hg released nationwide each year may exceed more than a ton. A more widespread study and careful volumetric analysis are needed to obtain a more accurate picture.

Whether Hg vapor levels exist-and to what degree -in sewage systems that receive discharge air directly still remains uncertain.

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We would expect the discharge amounts to be similar to the levels reported in this study, but the significance of occupational exposure to workers in that environment is a question for further study.

Table 1.—Concentration of Mercury (Hg) Vapors in Air Samples Collected at Test Sites

Site no.	No. dentists at office site	Concentration (mg Hg/m^3)
1	2	0.103 ± 0.011*
2	1	0.013 ± 0.001
3	5	0.237 ± 0.020
4	2	0.010 ± 0.001
5	10	0.168 ± 0.023
6	2	0.060 ± 0.011
7	2	0.023 ± 0.003
8	4	0.126 ± 0.001
Average concentration		0.092 ± 0.008

*Concentration values presented as means ± standard deviations.

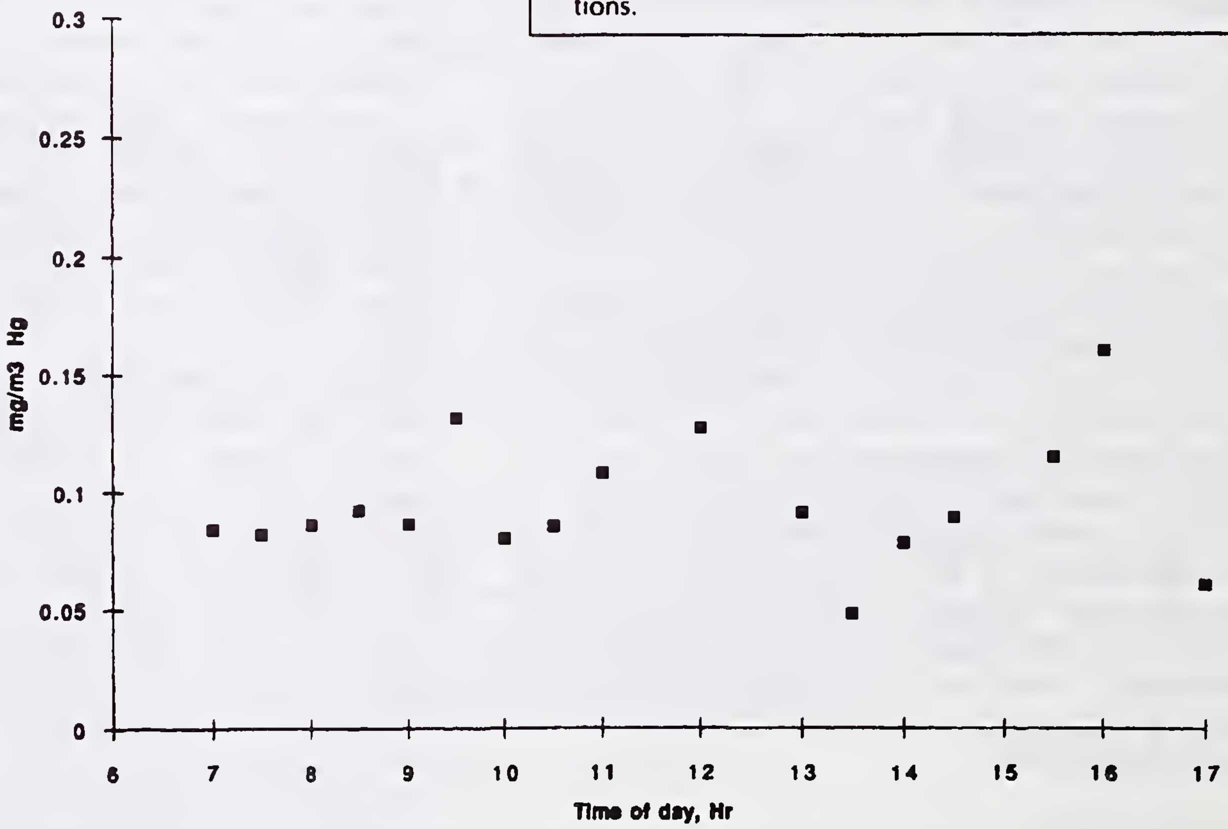

Fig. 1. Results of Hg analysis for air samples collected at site one during a day, from 7:00 A.M. to 5:00 P.M.

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Before this study, no data had been published about escape of Hg from dental waste material, under naturally occurring conditions. Release of Hg in our study occurred, absent any extremes of forces or temperatures; therefore, such a result appears to be cause for some environmental concern.

Results

All the air samples collected for analysis contained, on average, 0.092 mg Hg/m3. The level of Hg, however, varied markedly with sampling site and ranged from 0.010 mg/ml to 0.237 mg/m3 (Table 1). Mercury levels were higher in samples collected at sites of older dental offices than in samples obtained at newer offices. The two sites at which the lowest concentrations were found (sites two and four) were at newer offices that contained newer plumbing systems. No attempt was made to record the type of dental procedures that were performed on patients at the time the samples were taken. Some samples were obtained at times during which there was no active-dental treatment being performed by dentists.

The results of Hg analysis for air samples collected from 7:00 A.M. to 5:00 P.m. at site one are shown in Figure 1. During the day, a continuous output of Hg from this particular site was observed. Mercury levels ranged from 0.048 to 0. 160 mg/m3 (average = 0.094 m m3).

References

1. Craig RG (Ed). Restorative Dental Materials. St. Louis, MO: Mosby, 1980; pp 8-11, 163.
2. Vimy MJ, Lorscheider FL. Intra-oral air mercury released from dental amalgams. I Dent Res 1985; 64:1069-71.
3. Vimy Mj, Lorscheider FL. Serial measurements of intra-oral air mercury: estimation of daily dose from dental amalgam. I Dent Res 1985; 64:1072-75.
4. Patterson JE, Weissberg BG, Dennison Pj. Mercury in human breath from dental amalgams. Bull Environ Contamin Toxicol 1985; 34:459-68.
5. Vimy Mj, Lorscheider FL. Dental amalgam mercury daily dose estimated from intra-oral vapor measurements: a predictor of mercury accumulation in human tissues. J Trace Elem Exp Med 1990; 3:111-23.
6. Berglund A. Estimation by a 24-hour study of the daily dose of intra-oral mercury vapor inhaled after release from dental amalgam. J Dent Res 1990; 69:1646-51.
7. Reinhardt JW. Side effects: mercury contribution to body burden from dental amalgam. Adv Dent Res 1992; 6:110-13.
8. Engle JH, Ferracane JL, Wichmann J, Okabe T. Quantitation of total mercury vapor released during dental procedures. Dent Mat 1992; 8(3):176-80.
9. Visser H, Pieper K, Isemann M, Stalder K. A prospective study on the incidence of mercury levels in dental students. 11. Correlation analysis. Dutsch Zahnarztl Z 1991; 46(8):555-57.
10. Skare 1, Engqvist A. Human exposure to mercury and silver released from dental amalgam restorations. Arch Environ Health 1994; 49:384-94.
11. Welland C. Dental Office Waste Stream Characterization Study. Municipality of Metropolitan Seattle (METRO). Seattle, WA: Industrial Waste, MS Lab; 1991.
12. Occupational Safety and Health Administration. Safety factors. Fed Reg 1992; 57:26048.
13. American Dental Association. Chicago, IL: Department of Surveys, 1991.

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Appendix 3. Testing Protocol for Amalgam Separation Equipment

Demonstration Testing of Amalgam Wastewater Treatment Units

Goal: To consistently demonstrate a minimum of 90 percent removal of MERCURY from amalgam wastewater under representative conditions.

Each vendor interested in installing amalgam wastewater treatment units within Metro's service area must demonstrate to Metro that the system will consistently remove at least 90 percent of mercury under typical conditions*. This demonstration must include installing the unit in representative dental offices. (For the period July 1, 1994 to May 1, 1995 "representative dental offices" must include a minimum of three King County dental offices). Vendors must provide Metro with both a description of the specific testing conditions associated with each demonstration dental office and the Monitoring Plan for the demonstration period. The Monitoring Plan should include: (a) a diagram and photo showing sampling location and treatment unit placement in relation to chairs and vacuum pump; (b) composite sampling procedure; (c) sample splitting procedure; (d) sampling handling procedures; and (e) number of samples.

Based on Metro's experience in characterizing wastewater from dental offices and the performance of pretreatment systems in other settings, the following are minimum demonstration requirements:

1. ESTABLISH SAMPLING POINT. In most cases the sampling point will remain constant throughout the test period, therefore advance consideration for the location of the sample point in relation to the installed unit must be considered. The point of sampling will usually be located between the operatory chair and the vacuum pump, but in all cases sampling must occur before amalgam wastewater mixes with water that will not be treated by the amalgam wastewater treatment unit.

2. SAMPLE TO ESTABLISH MERCURY CONCENTRATION IN UNTREATED WASTEWATER. Prior to the actual installation of the amalgam wastewater treatment unit, sampling must consist of a minimum of five continuous weeks of operation to establish a mean weight of discharged mercury (in grams) based on weekly mercury concentrations and wastewater volumes. For each amalgam removal unit, a minimum of one composite sample per week must be collected totaling a minimum of 5 composite samples prior to installation. Each weekly analysis must consist of all the representative composite samples (one or more) taken that week. For each sample, the total volume of wastewater and the volume of the sample must be reported. Total weight of mercury can then be calculated. Each sample must be analyzed by an EPA or WDOE certified laboratory for total mercury using EPA

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Method 7470 (or equivalent, e.g. Method 245. 1). Please refer to "Recommended Sampling Protocol for Dental Amalgam Wastewater".

3. INSTALL THE TREATMENT UNIT. The treatment system must be installed in a minimum of three dental offices for each type of vacuum system (wet vs. dry) for which certification is sought. The offices should be those which routinely work on several amalgam placements or removals per day.

4. SAMPLE TO ESTABLISH MERCURY CONCENTRATION IN COLLECTED SLUDGE AND TREATED WASTEWATER. Following installation of the treatment unit, the total grams of mercury collected over the five week post-installation test period must be reported based on the total weight of the collected solids and its mercury concentration.

   In addition, for those treatment units installed upstream of the vacuum pump, treated wastewater must be collected. Sampling shall consist of a minimum of five continuous weeks following installation, totaling a minimum of 5 weekly composite samples. Each weekly analysis must consist of all the representative composite samples (one or more) taken that week. Samples should be taken downstream of the installed unit and should not be taken until the unit has reached a "steady state". As in #2 above, these samples will establish a mean weight of discharged mercury (in grams) based on weekly mercury concentrations and discharged water volumes.

5. REPORT TO METRO. Along with the sampling results obtained for each installation, the vacuum drop associated with the amalgam wastewater treatment unit - both objectively (inches of Hg via gauge) and subjectively - must be reported. Further, the transferability of collected sludge and the method of infection control must be explained. Finally, a description of the attention required by the vendor or dentist for proper operation/maintenance must be provided.

Questions regarding these requirements should be directed to Rick Renaud, King County Industrial Waste Investigator, at (206) 689-3007.

*'Typical conditions' include, but are not limited to, the standard practice use of in-line amalgam screens and traps.

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Appendix 4. Recommended Sampling Protocol for Dental Amalgam Wastewater (10/24/94)*

These recommendations are to be used in conjunction with King County's "Demonstration Testing of Amalgam Wastewater Treatment Units". They apply to the sampling of treated and/or untreated dental amalgam wastewater collected after the operatory and before the vacuum pump. The sampling "collector" accumulates all operatory wastewater produced during the week (sample). The total volume is then measured and a representative portion taken for laboratory analysis (subsample).

1. Sampling set-up

- Fittings, tubing and sampler should be installed to avoid rough or low spots where particulate may collect and thus not reach the sampling collector.

2. Sample collection

- To obtain representative samples it is important that there are no major deviations from the typical operatory routine. Do not flush the lines with excess water before or during sampling.
- Most of the metals will be in the particulate matter. Care must always be taken in the collection, splitting and subsampling of samples with particulate to *assure that the particulate is evenly distributed* so that the sample is truly representative of the wastestream.
- Mix sample within the collector well before subsampling. Cap and invert the collector 8 - 10 times and then swirl while pouring sample(s) to keep the particulate well distributed.
- Pour at least one duplicate sample (for analysis) of untreated wastewater during the first 5-week test period and one duplicate of treated wastewater during the second five-week test period to demonstrate representative splitting technique.
- Measure subsample volume and total sample volume such that sample integrity is maintained.
    - Pour all samples, including duplicate(s) into measured sample bottles (approx. 500 mL).
    - Pour remaining collected sample in a graduated cylinder (approx. 1 - 5 L). Some residue may remain, especially in untreated samples.
    - Rinse particulate residue from the sample collector 2-3 times with a little of the supernatant from the top of the graduated cylinder. Assure that whatever residue film remains is insignificant for volume measurements.
    - Total the volumes: sum the volumes of those samples poured into the sample bottles and the remaining volume poured from the collector into the graduated cylinder. Record total volume.

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- Preserve sample(s) with nitric acid to pH<2. Your laboratory may be able to provide this service if sample(s) can be delivered to them immediately.
- Follow the analytical laboratory sample handling procedure.
- Record type and volume of disinfectant used in the dental office.

* This protocol was developed to assure sample integrity and interpretable data and is based upon the 1992/93 Dental Amalgam Separation Study conducted by the Local Hazardous Waste Management Program in King County

3. Analysis

- Notify the laboratory of the type of sample and the anticipated high levels of metals in the untreated wastewater samples (e.g. up to 2000 ppm mercury). High concentration of metals can cause instrumentation contamination and carryover. The laboratory instrument used for mercury analysis has a narrow and very low linear range which likely will require sample dilution at and by the laboratory before analysis.
- The lab should use care in subsampling and dilutions. Dilutions of 1/10,000 or more may be necessary for untreated samples. Digesting the entire submitted sample and then making serial dilutions using digestion acids may be the best approach. The lab's QA/QC data should verify this.

4. Quality Assurance/Quality Control

- Use clean sample bottles of a known volume. Test for contamination. Soak in nitric acid solution, if necessary. Your laboratory may provide appropriate bottles or help in bottle selection.
- Clean the sample collector bottle:
    - Rinse and wash a 4 Liter or larger sample collection bottle.
    - Soak sample collection bottle and lid in disinfectant (Collect a sampler blank to check for possible contamination from the disinfectant; if detected the disinfectant should be changed before sampling begins. Wescodyne seems to work well.)
    - Rinse thoroughly (8x) with warm or hot tap water
    - Rinse 3x with deionized water
    - Shake out and cap bottles
- Use a "new" sample collector after installing the amalgam removal unit. The expected high levels of metals in untreated wastewater will likely contaminate the sample collector used in the first five-week phase of the testing protocol.
- The lab should provide QA/QC information for blanks, standardization, standard reference materials, dilution factors, serial dilution analysis, sample replicates and spikes for every analytical batch (and every ten samples if a batch exceeds ten samples).

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5. Safety

- Untreated dental wastewater must be handled with caution due to its potentially infectious and hazardous characteristics. It is probably prudent to handle according to bloodborne pathogen procedures.

Appendix 5. Tested Amalgam Separators

The Industrial Waste section of King County has received data from the following vendors as evidence that their specified unit is at least 90% effective in removing amalgam from dental wastewater in the Seattle area.

- DRNA (tel. 800-360-1001)
- Metasys (tel. 905-528-0078)
- R&D Services (tel. 206-525-4994)
- Rebec (tel. 800-569-1088)
- Safety-Kleen (tel. 800-669-5984) approval status unknown at this time.

Note: King County acknowledges that there may likely be several other market-available amalgam separation units or technologies which can meet the minimum 90% removal criteria, but data for these units have not been submitted for our analysis. For example, there were a number of other vendors who began demonstration testing in Seattle but withdrew from the process in response to the county's decision to postpone the dental waste rule promulgation. Contact Rick Renaud (206-689-3007) for more information.

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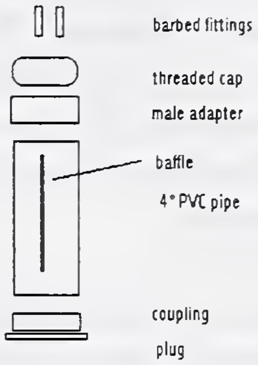
Appendix 6. Dual Chamber Amalgam Waste Separator

Materials:

4'' schedule 40 PVC pipe
    2@ 12 inches
4" PVC plug
    2 each
4" PVC coupling
    2 each
4" PVC threaded cap
    2 each
4" PVC male adapter
    2 each
clear silicon caulk
    1 each
baffle: plastic panel (cut from waste basket)
    2 @ 4+" X 12"
PVC glue
    1 each
Nalgene barbed bulkhead fittings (size to fit vacuun
    2 each
vacuum tubing
    size to fit operatory, several feet



Cost of Materials: Approximately $60.

Tools:
electric drill   drill bits: 1/8", 5/8" paddle, 1 1/8" paddle
screw driver   pliers   hand saw
utility knife   straight edge   bar clamp
keyhole saw or similar tool

Assembly (make two):

1. Mount barbed fitting in cap according to instructions. Depending on cap thickness, you may need to recess holes.*
2. Make two shallow cuts at opposing angels along inside length of pipe for baffle. Use jig for straight cut.
3. Cut plastic baffle and pressure fit into slots. Mark location of baffle on outside of pipe.

4. Assemble and glue together PVC parts (except threaded cap.) When assembled, baffle will be several inches above bottom of chamber to allow for sludge accumulation and several inches of headspace at the top of the chamber.
5. Push short piece of hose or other tubing over inside of barbed fittings. The one on the inlet side is to guide wastewater into one of the chambers. A longer one on the outlet side is to extract treated effluent. Hoses must not extend beyond top of baffle.*
6. Screw cap on, noting position of inlet and outlet relative to baffle.
7. Test and seal with silicon caulk as necessary.
8. Insert both units in series in vacuum line between operatory and pump using vacuum hose as needed.

*Alternately, mount one barbed fitting off center in cap for inlet and other barbed fitting near top of pipe for outlet. Special gaskets or shims may be required to fit curved surfaces.

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***Paul Rubin**, DDS, FIAOMT is co-chair of the Environmental Committee of the International Academy of Oral Medicine and Toxicology, where he also serves on the Board of Directors. Dr. Rubin's private practice in Seattle was one of the first in the nation to install an amalgam separation device. He received the Individual Award for Environmental Achievement from the Puget Sound Waste Information Network in 1997 and was a Runner-Up in the Governor's Award for Pollution Prevention in Washington State in 1997. He graduated from the University of Washington School of Dentistry and can be contacted at 310 Harvard Avenue East, Seattle, Washington 98102. Phone: (206) 324-1100. Fax: (206) 324-6711.*

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Dental Office Waste Management: Safety and Regulatory Compliance Issues.

- Regulatory Compliance
- Accreditation & Certification Preparation
- Corporate Compliance

Topics to be covered

- Waste management safety & liability areas of concern in dentistry
- Specific OSHA issues related to waste management
- How to develop your own compliance program

WHAT HAPPENS TO YOUR WASTE?

by MedSafe's Compliance Department

A typical response -"Some guy picks it up, and he takes care of it. What they do with it is their problem!" Unfortunately, it is your problem and the ultimate disposition of waste is your responsibility. The term "Cradle to Grave" is commonly used when discussing regulated waste issues. If you generate regulated waste (sharps, fixer solution, others) you are responsible for it ..forever. It is very important that you check with your waste hauler for appropriate licensing. If your questions are not taken seriously or are responded to in a defensive manner, you might consider looking elsewhere .. there are many!

The following guidelines should be helpful in locating an acceptable Treatment Storage and Disposal Facility (TSDF):

Initial screening

During the initial screening of a TSDF, you should ask for a copy of permits held by the company. It is important to see that the waste hauler has a current permit and is licensed to accept and treat your particular type of waste. This information should be readily available.

You should also ask specific questions concerning qualifications and training of their staff members. Their employees must be trained in Occupational Safety and Health Administration (OSHA), Environmental Protection Administration (EPA), and Department of Transportation (DOT) regulations.

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Your interview should also determine the type of treatment that will be rendered for your particular types of waste. You need to know if your waste will be incinerated or if it will be buried in a landfill--where it can eventually come back to haunt you!

Take the Tour

Consider conducting an on-site tour of the waste facility. While in many cases this may not be practical, you might ask your professional association to go for you. As unexciting as it sounds, it could save you from making a costly mistake. If the waste is not disposed of properly, if it's found washed up on a beach somewhere, you, as the generator of that waste, are the one who pays.

If you visit, you should be interested in seeing the storage and treatment areas of the facility. Assess the geographical location of the facility and its potential ramifications. For example, if it is located in a neighborhood, next to a playground, or near a stream, it is probably not your best choice. It may still be acceptable but there should be an in-depth review of health and safety practices, storage containment and transfer stations, security and warning signs, etc.

Again, appropriate operating permits should be reviewed and copies retained for your files. It is important to know that even though that generator possesses a permit, this does not relieve you of responsibility for proper disposal of your waste. Permits may be expired or revoked. A call to the state licensing authorities is probably well advised.

Financial Resources

Examine the financial health of your waste hauling company. Financial resources need to be adequate in case the waste facility is closed. If it lacks adequate financial resources, the generator--that means you, again--can be tapped for the cost of closure.

Choosing a TSDF requires more study than merely analyzing the cost and frequency of pick-up of your waste. Take a few steps now to minimize your risk. Be wise, be informed, and be responsible.

Waste Management in context...
... how you deal with waste is part of your facility's overall compliance program...

Patricia White
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- Safety/Risk Management Program Components

  - Facility Safety Policy Statement

- Hazard Communication and Exposure Control Program
  - Program Overview
  - Program Summary

- The Hazard Communication Plan (HCP)
  - Hazard Communication Standard

- Hazardous Chemical Inventory Procedure
  - Hazardous Chemical Definition

- Material Safety Data Sheet (MSDS) Overview

- Hazardous Chemical Labeling
  - Chemical Labeling Guidelines
  - MedSafe® Hazardous Material Identification Chart

- Exposure Control Plan (ECP)
  - Occupational Exposure to Bloodborne Pathogens

- Exposure Determination

- Epidemiology: Diseases and Symptoms

- Universal Precautions

- Clinical Protocols
  - Standard Operating Procedures (SOPs)
  - Handwashing
  - Glove Protocol
  - Treatment Area Maintenance Protocols
  - Laboratory Procedure Protocols
  - Housekeeping
    - Protocols for Using Chemical Disinfectants/Sterilants
    - Cleaning & Decontamination Protocols
    - Blood Spill Protocols
    - Laundry
    - Waste Management
  - Communication of Hazards

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Hepatitis B Virus (HBV) Vaccination Program

Post–Exposure Evaluation and Follow–Up

Training and Communication

Recordkeeping
- Employee Training Acknowledgment
- Contractor Training Acknowledgment (Optional)
- Fire Extinguisher Location Chart (Optional)
- MSDS Request for New Products
- MSDS Request For In–Stock Products
- Hepatitis B Vaccination Status Form
- Hepatitis B Vaccination Declination Form
- Post–Exposure Evaluation Packet Summary
- Post–Exposure Evaluation Check–Off List
- Source Individual Post–Exposure Notification
- Accident Investigation/Incident Report
- Employee Post–Exposure and Follow–Up Examination Status Form
- Healthcare Professional Opinion Form (Exposed Individual)
- Healthcare Professional Opinion Form (Source Individual)
- Cleaning and Decontamination Schedule
- Spore Testing Log (Optional)
- PPE Monthly Inspection(Optional)
- PPE Monthly Inspection Log (Optional)

TB Section

Appendix A: Standards
1. .... Hazard Communication Standard (29 CFR 1910.1200)
2. .... Occupational Exposure to Bloodborne Pathogens
3. .... Access to Employee Exposure and Medical Records (29 CFR 1910.20)

Appendix B: Glossary of Common Terms

Appendix C: Sample OSHA Forms

Appendix D: References Not Cited

MedSafe Order Forms: .... MedSafe Order Forms

Appendix E: Resource Guide

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Regulatory and Accreditation Requirements at a glance...

Healthcare Organizations

☐ REGULATORY COMPLIANCE*

☐ **OSHA Compliance**
- On-site Audit of Hazards & Documentation
- Review of Exposure Risks
- Written Report of Recommendations
- Hazard Communication
- Bloodborne Pathogens
- TB Prevention
- Ergonomics
- Lifting Safety
- **Violence in the Workplace**
- **General Safety**
- Lock Out /Tag Out
- Fire/Electrical Safety

Air
Quality

- Ladder Safety/Fall Protection
- **MSDS Management**
- **Hazardous Product Labeling System**

☐ **CLIA Compliance**
- On-site Audit with Recommendations
- Procedures Manual Development
- QA/QC Programs
- Initial Staff Training
- Ongoing Program Maintenance

☐ **ADA Compliance**
- Title III, Facilities Audit
- Written Barrier Removal Plan
- Compliance Documentation
- ADA Sensitivity Training

☐ **Controlled Substance Management**
- On-site Audit with Recommendations
- Compliance Documentation

Initial Staff Training

- Ongoing Program Maintenance

☐ **Multi-Site Safety Management**
- Information and Reporting System

☐ **Program Maintenance**
- Program Updates
- New Hire Training

*All programs must be site-specific

☐ CORPORATE COMPLIANCE

- Evaluation
- Documentation
- Training
- Fraud & Abuse
- Stark I/StarkII

☐ ACCREDITATION PREPARATION*

☐ **Managed Care Compliance/POC**
- Survey Preparation (JCAHO, AMA, NCQA, AAAHC)
- Utilization Management
- Credentialing
- Preventative Health
- Rights and Responsibilities
- Medical Records
- Quality Improvement
- Practices & Procedures Development

☐ LOSS REDUCTION/RISK MANAGE

☐ **Employee Policies**
- Employee Handbook
- Harassment Training
- **Violence in the Workplace**

☐ **Due Diligence**
- Purchase/Sale Reporting
- Facility Risk Management

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Compliance and Accreditation requirements for Dental and other Healthcare Facilities

General areas to be addressed by a dental organization include the following:

A. Safety and Regulatory Compliance Requirements

Primary Components

1. OSHA Compliance and Hazard Assessment
A thorough review of your facility's practices and procedures, work environment exposure risks and existing risk management/safety programs should be conducted, with formal written recommendations provided to management, to assist in the development and implementation of appropriate corrective actions.

2. Safety Compliance Manuals and Documentation
The organization or facility must develop facility specific Compliance Manuals and documentation including OSHA's Hazard Communication, Bloodborne Pathogens and General Safety standards individualized to each facility plus abstracts and reference materials for relevant regulations. (This could include state mandated X-ray, Chemotherapy, safety committee or other written safety plans as specified.)

3. Material Safety Data Sheet (MSDS) Manuals and Product Labels
A time-consuming, yet critical component of a facility safety program is the assembly of required MSDS Directory and Catalog individualized to your facility, along with labels for all hazardous products transferred to secondary containers.

4. Staff Training
Complete Staff Training should be provided through on-site trainings at your facility, consisting of approximately 3 hours of instruction per session (in satisfaction of OSHA's 29 CFR 1910.1200 and 29 CFR 1910.1030).

5. Ongoing Program Maintenance
The employer must make an ongoing commitment to program maintenance, through (a) continuing documentation updates reflecting new or revised regulations, specific advisories and newsletters, (b) ongoing training availability for new hires, and training for all staff as regulations change, (c) ongoing MSDS acquisition and documentation update, (d) a program of follow-up inspections and site visit reports to management, as well as required annual training of staff and, (e) automatic on-site training in the case of a change in a facility's Program Coordinator.

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B. Accreditation Preparation Requirements

Primary Requirements

1. On-Site Survey and Report

A thorough review of areas important to facility accreditation issues should be conducted, including:

- Office environment
- Practices and procedures
- Appointments and scheduling
- Quality Management
- Medical records
- Policy documentation
- Informed consent, follow-up
- Medication
- Billing and collections
- Safety and infection control
- Contracts
- Termination of care
- Other specialty specific protocol

2. Development of Required Documentation

For any deficiencies identified, physician organization management must then continue with development of required plans and/or practices and procedures (including any plans identified under 'other regulations', see section C below, if necessary).

3. Orientation to Accreditation

Accreditation preparation involves changes in organizational culture and procedure. Facility Coordinator(s) should be designated. These individuals will take a substantial part of their time training staff, and conducting workshop/conferences with management as to performance oriented ongoing responsibilities for accreditation and MCO provider contract maintenance.

4. Ongoing Services

Regulations change, thus the facility Program Coordinator's job description into the future will include revision of plans and/or practices and procedures developed in this MCO/NCQA compliance program as driven by MCO/NCQA initiative.

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C. Other Regulatory Requirements/Suggestions

1. Safety Committee

If not already in place, a safety/accreditation committee provides an excellent vehicle to support ongoing training and program-related implementation issues.

2. Americans with Disabilities Act (Title III) Compliance

An on-site facility and compliance audit, preparation of barrier removal plan and office policy and ADA awareness training for staff is required for all healthcare facilities.

3. Controlled Substance Management Program

An on-site audit of your facility's degree of compliance with the Federal Controlled Substances Act, written recommendations for corrective measures and a complete training program and manual providing required protocols and documentation should be conducted for all applicable facilities.

4. High Risk TB Exposure Control Plan

A manual based on current CDC recommendations that includes a TB policy, screening and testing procedures, treatment, control measures, recordkeeping forms and the tools for performing a risk assessment should be created, and staff members trained on program components. May be required depending on facility type.

5. Radiation Safety Plan

A plan developed according to specific state laws that describes standard operating procedures, registration requirements, personal protective equipment and barrier requirements, radiation dose limits and monitoring, handling of regulated waste, and provides recordkeeping forms and required postings. May be required depending on facility type.

6. Employee Policies Program

Every facility should develop an Employee Handbook and employee policies covering benefits, work hours, vacations and holidays, sexual harassment, snow days, hiring, disciplinary actions and some 40 other employment related issues. Such a program has been demonstrated to deflect lawsuits and liability exposure.

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Regulatory & Accreditation Readiness Quick-Test

Does the facility have a written protocol for an Informed Consent process between the doctor and patient, clearly defining the criteria for when Informed Consent is warranted?	☐ Yes	☐ No
Does the facility have a Chaperone Policy that defines when a chaperone should be offered to a patient?	☐ Yes	☐ No
Does the facility have a Confidentiality Policy defining restrictions on utilizing answering machines when leaving messages for patients?	☐ Yes	☐ No
Does the facility have a *Hazard Communication/ Bloodborne Pathogens* manual customized with facility-specific information?	☐ Yes	☐ No
Does the facility have a written controlled substance (DEA) management program, including accounting controls?	☐ Yes	☐ No
Does the facility have a written Americans with Disabilities Act Barrier Removal Plan? (required by law)	☐ Yes	☐ No
Is there an eyewash, and is it properly mounted and accessible?	☐ Yes	☐ No
Has industrial hygiene and x-ray monitoring been conducted?	☐ Yes	☐ No
Does the facility have a written Employee Policies Manual, including harassment, workplace violence, and discrimination?	☐ Yes	☐ No
Does the facility have a written protocol for surface disinfection?	☐ Yes	☐ No
Does the facility have a written TB Prevention Program	☐ Yes	☐ No
Does the facility make Hepatitis vaccination available to all “at risk” employees, and is this program documented?	☐ Yes	☐ No
Does the facility follow a formal, written Post-Exposure Evaluation and Follow-Up protocol for use in the event of an exposure incident?	☐ Yes	☐ No
Does the office have MSDSs for every product in use, organized for quick access? (Generic, non specific MSDSs do not count!)	☐ Yes	☐ No
Do all secondary containers have appropriate hazard labels, and does labeling system cross-reference with MSDS Book?	☐ Yes	☐ No
Are fire and evacuation plans documented?	☐ Yes	☐ No
Is on-site *job-specific* annual Staff Safety Training provided by a qualified instructor? (required annually by OSHA)	☐ Yes	☐ No

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Section 5: Total Quality Management

Robert Luttman
Robert Luttman & Associates
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Process Inefficiency Breeds Medical Waste

The healthcare industry is rife with potentially dangerous toxins. Radioactive, chemical, biological, and pharmaceutical waste products pose a danger inside and outside healthcare facilities. Air quality issues have forced some hospitals to redesign HVAC systems, and even ban latex balloons. Routine procedures require masks and gloves to eliminate the risk of blood and fluid borne infections. Nosocomial infections – those acquired during care – are a constant concern.

Many of these risks are endemic in healthcare and the chemicals, drugs, and equipment used to treat patients. Many are endemic in the treatment of patients suffering from infectious diseases. Proper precautions and processes can reduce the level of risk and manage what risks remain.

Total quality management plays a role in reducing the toxic waste problem in healthcare, as it does in other industries. Wasteful and inefficient processes that use toxic products increase toxic waste. The key to eliminating waste, inefficiency, and rework in processes is total quality management.

Pharmacy processes are an example of the effect quality management tools and techniques can have on toxic waste. Many drugs are dangerous toxins. Processing drugs often requires laminar flow air hoods that vent directly to the outside. Disposing of many drugs, and their accompanying syringes and needles, is a biohazard issue. Quality management tools and techniques have addressed several drug delivery system issues that increase toxic waste:

- When a patient transfers from one nursing unit to another the pharmacy system was not updated in a timely manner. The patient's drugs were delivered to the old unit – and consequently returned – while the new unit was ordering additional drugs. The effect was wasted drugs.
- Physicians' orders were not communicated to the pharmacy in time and (now) unnecessary medications were produced and delivered, then returned. More wasted drugs.
- Most drugs have short shelf lives. Poor production and inventory control practices that produce an overstock increase the amount of medications expiring unused.
- Poor quality in the medication manufacturing process leads to waste and rework.

A series of quality management projects addressed these issues and created a new order entry system and a new pharmacy delivery system. The end result was improved process efficiency and reduced toxic wastes.

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Quality management tools have addressed similar issues in other waste generating processes: radiology, operating rooms, central processing departments (which sterilize instruments and equipment using toxic gases), and clinics.
Conversely, control charts are increasingly used to address nosocomial infections – infections acquired during treatment. Control charts identify when a statistically significant event – or events – have occurred. This triggers an investigation and improvement effort. Control charts tell when and where an infection outbreak has occurred, focusing the organization's resources on ending the outbreak and preventing future outbreaks. Since nosocomial infections are often the result of poor processes, or poor compliance with process guidelines, infection control efforts often become process improvement efforts and use quality management tools and techniques.

Quality management provides powerful process improvement tools and techniques. When used on processes with toxic outputs these tools become powerful toxic waste reduction tools. The use of quality management tools has a proven track record in healthcare of improving cost and quality. They have also reduced the potential toxic waste output of these lifesaving services.

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Section 6: Government Initiatives

Gail Savina and Susan McDonald
Local Hazardous Waste Management Program
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Barriers to Reducing Mercury Pollution From Dental Offices in King County, Washington

Since 1991, the King County Local Hazardous Waste Management Program (LHWMP) has actively worked with dentists to reduce mercury pollution through technical assistance and outreach programs. This paper describes methods used to investigate the introduction of pollution prevention techniques and details barriers that must be overcome for dentists to begin reclaiming mercury-bearing wastes.

Introduction and Background

Historically, mercury has appeared as a problem in Pacific Northwest wastewater treatment systems. The imminent listing of one or more salmon species as endangered again focuses attention on Northwest water quality issues.

Previous studies in the region indicate that dentists in King County are responsible for 14 percent of the total mercury entering the sewer system (more than from any other business sector). This amounts to 51 pounds of mercury per year entering the local sewer system as amalgam particles and is about a quarter of all amalgam waste generated by dentists. A 1997 audit of dental offices indicated that only 20 percent reclaim some of their amalgam waste (usually dry scrap) while less than a dozen offices have installed wastewater treatment units.

Reducing pollution from mercury-bearing amalgam wastes requires a change in operations and often the introduction of new technology. Dental offices must collect these wastes and send them to a mercury reclamation facility. Collection must occur at a number of points: dry (non-contact) scrap amalgam, chairside trap solids, pump filter solids and particles in the wastewater. Above all, collection and reclamation of these amalgam wastes involve a change in behavior.

Behavior Change

A growing body of literature on behavior change suggests that technology alone is not sufficient to change behavior. Rather, behavior change requires a systematic approach to understanding the audience and its barriers to adopting a new technology or system to prevent pollution. If barriers to change are accurately identified, program strategies can more effectively persuade the audience to adopt the new technology or system.

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Local Hazardous Waste Management Program
King County, Washington

Methodologies Used to Identify Barriers

In King County, a combination of methods were used over a number of years to learn how the dental community deals with waste management issues as well as the barriers to introducing pollution prevention practices.
Methods include:

- Waste samples from chairside traps, pump filters and operatory wastewater were analyzed to quantify the extent of mercury contribution from dental offices.
- Written surveys provided self-reports on waste disposal, attitudes toward reclamation, preferred information sources, and perceived needs.
- Field data from visits to dental offices documented waste disposal practices, attitudes and knowledge levels of dentists through direct observation.
- Key informant interviews with selected dentists provided in depth data about waste disposal decision-making, credible information sources, attitudes toward the government and views on marketing. Interviews with vendors provided insights into technological developments and the market situation for reclaiming dental amalgam waste. Interactions with the county and state dental associations and with the University of Washington Dental School supplemented this information.
- Literature reviews encompassed publications about similar programs elsewhere; local, state and national dental journals; research studies on the adoption of innovations by dentists; and studies on health and safety effects of amalgam and mercury.

Barriers to Reclamation of Mercury by Dentists

We found that dentists' barriers to amalgam reclamation fell into three areas – technical barriers, organizational resistance and personal barriers.

Technical barriers include logistical problems and those aspects of the external environment that impede a desired change. In the case of amalgam reclamation by dentists in King County, these are:

- Lack of reclamation options. Few (one or two) haulers are available to pick up amalgam wastes from dentists in King County. Lack of a viable market means costs are higher. Mail-in services or drop-off programs are the only other options.
- Dental offices are not standardized, and a wastewater treatment unit may or may not fit into a particular office. Most available treatment units do not technically meet county discharge levels for mercury.

Organizational barriers are those aspects of the social structure that stand in the way of desired change. They include:

- Dentists are highly organized within a hierarchical structure in which the national agenda influences local dentists. In this case, the national association resists identifying amalgam as an environmental or health hazard and opposes government involvement in internal operations.
- Dentists are difficult to contact directly. Information is filtered through professional associations, suppliers, schools and office employees.
- The region's leading dental school has no coordinated unit on waste management. Information is scattered throughout the syllabus.

Personal barriers include aspects of the individual, such as attitudes and level of knowledge, that stand in the way of change. In the area of amalgam reclamation, these include:

- Knowledge about the importance of amalgam reclamation is low. Most dentists consider it infectious waste and dispose of it in the 'red bag' (which is ultimately burned).
- Cost of pollution prevention equipment and reclamation services is a new cost for most dental practices.
- Dentists distrust the government as a source of information. They dispute the environmental impacts of mercury-bearing amalgam.
- Dentists don't link their own practice with environmental issues.
- Time can be a barrier; dentists are busy and don't consider waste management a priority.

With an understanding of these barriers, the King County LHWMP program is now developing and implementing strategies to introduce pollution prevention to dentists.

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Health Care Mercury Elimination and Reduction Memorandum of Understanding (MOU)

Pollution Probe is a non-profit environmental organization located in Canada. Over the past three years, as part of the Mercury Elimination and Reduction Challenge (MERC) project, Pollution Probe has worked in partnership with many stakeholders on mercury pollution prevention issues. One of the major focuses of this project has been the reduction of mercury in the health care sector.

In April 1996, a *Mercury Pollution Prevention in the Health Care Sector Workshop* was held which examined the effects of mercury on human health, presented examples of mercury pollution prevention case studies in the health care sector, and reviewed some alternatives to mercury containing products and devices. The ***Health Care Mercury Elimination and Reduction Memorandum of Understanding (MOU)***, a voluntary pollution prevention agreement for Ontario, was signed at this workshop. Signatories of the MOU included: Centenary Health Centre; the Hospital for Sick Children; The Toronto Hospital; Environment Canada; the Ontario Ministry of the Environment; the Health Care Environment Network (HCEN); and Pollution Probe.

Each of the current hospital signatories has developed their own strategy and policy for reducing and eliminating mercury. The MOU signatories and other hospitals have formed the Ontario Mercury Health Care Steering Committee. This Steering Committee was formed to encourage information sharing and to promote the elimination and reduction of mercury-containing products in the health care sector. Hospitals in Ontario, together with Pollution Probe, recognized the need to develop cost information on mercury-free products to assist with the process of reducing mercury use. The *Mercury in the Health Care Sector: the Cost of Alternative Products* report compares the costs of some of the hidden training, disposal, administrative, health, and environmental costs associated with the use of mercury containing products.

This project has been expanded to encourage hospitals across Ontario to sign the MOU. Pollution Probe and the Health Care Environment Network (HCEN) organized a session at the Ontario Hospital Association's (OHA) annual conference in November, 1997. The Health Care MOU was highlighted as a specific, achievable pollution prevention initiative currently being undertaken by Ontario hospitals. Pollution Probe is also planning to expand the MOU to Atlantic Canada.

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Wisconsin's Environmental Cooperation Pilot Program
Breaking Through to Enhanced Environmental Performance

Wisconsin's healthcare providers, waste handlers, environmentalists and state government are pioneers; working together to reduce the generation and incineration of medical waste. Initial collaboration has led to rules that address both the environmental and safety concerns of medical waste. Rather than mandate percentages of reduction, these rules require each medical facility to implement its own plan for medical waste reduction. These plans include elements common to performance based environmental management systems (EMS). For example, each facility must commit to the waste reduction hierarchy; examine potential cost savings; consider impacts on clients; improve waste handling practices; evaluate purchasing practices; train employees annually and consider internal incentives for continuous improvement. Healthcare administrators sign annual reports to DNR to demonstrate top management support of improved environmental performance. The department is now building on the success of our medical waste reduction program, to address other environmental concerns.

When evaluating what areas of improvement could be included in healthcare, a systematic review of healthcare impacts on the environment will be key. The Environmental Cooperation Program is a pilot program designed to evaluate alternative methods to compliance based environmental management. Traditional "command and control" regulatory strategies can be costly leaving the healthcare organization with few alternatives to improve environmental performance. The program builds off an environmental management system based on a continuous quality improvement model to design a facility specific cooperative agreement. Cooperative agreements embody a whole-facility, multi-media approach. In addition, the program expects a strong stakeholder element to successfully negotiate an agreement. Agreements will be designed to promote the overall reduction in levels of pollution through a more flexible approach. The agreements overlay permits and approvals, and offer latitude to reduce administrative burdens or supersede certain requirements of permits and approvals during the agreement's effective period. The department will spend the next 5 years cultivating up to ten cooperative environmental agreements.

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WISCONSIN'S MEDICAL WASTE REDUCTION PROGRAM

Wisconsin has developed and implemented a comprehensive program for reducing medical wastes involving many public and private entities. The state legislature has adopted policies on incineration, recycling, and medical waste reduction; the state Department of Natural Resources has written and implemented regulations for managing and reducing medical waste; hospitals, clinics and nursing homes have implemented medical waste reduction plans and complied with the state's recycling law; and environmental groups have worked to remove non-regulatory challenges to waste reduction. Together, the groups have made substantial progress in reducing medical waste in Wisconsin.

Background In the 1980's, widespread concern developed about medical waste due to media reports of syringes found on public beaches. While Wisconsin chose not to participate in the federal medical waste program, it had concerns of its own. Public opposition to new commercial incinerators was high. With the support of environmentalists, the state developed new toxic air emission regulations controlling emissions from medical waste incinerators in 1988. At the time, the hospital association opposed these new regulations but was unable to stop their promulgation.

A 1991 study revealed that the state had capacity to treat more infectious waste than it generated and in fact was a net importer of medical waste from around the region. Non-infectious items were often mixed with infectious items leading to a disproportionate amount of waste being handled as infectious and ultimately, for the most part, being incinerated. Because wastes were mixed, many of Wisconsin's medical facilities were burning recyclable waste along with their infectious waste. (In Wisconsin, medical waste is defined as "infectious waste and other waste that contains or may be mixed with infectious waste".)

Wisconsin's program has progressed through several stages: developing policies, writing regulations, implementing the requirements, meeting the challenges of these efforts and continuing to evolve the program.

Policies In the early 1990's, the state legislature established a moratorium on the construction of new medical waste incinerators, adopted a recycling law, and charged the Department of Natural Resources (DNR) to develop rules for managing and reducing medical wastes. The rules were to emphasize the separation of infectious from noninfectious waste and to require medical facilities (hospitals, clinics and nursing homes) to develop *and implement* medical waste reduction plans. To our knowledge, no other states require implementation of medical waste reduction plans.

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Regulations The DNR invited healthcare providers, environmental groups, waste haulers and others to help write the rules (NR 526, Wis. Adm. Code), which were adopted in 1994. Wisconsin's medical waste rules define terms, establish requirements for packaging, handling, storing, shipping and transporting medical waste. They establish requirements for medical waste reduction by hospitals, clinics and nursing homes. The rules complement the state's recycling laws by promoting better waste management practices and alternatives to disposables in healthcare.

The rules assume that the volume of legally "infectious" material generated is relatively small compared to the overall waste produced at any one facility. The rules also assume that source separation is the best method and single most important step for reducing the amount of waste which must be treated as infectious. The rules explicitly require all infectious waste generators to separate wastes at the source, including individuals who generate sharps.

The rules assume that self-implementing programs for waste reduction which meet a base level of effort are more efficient and cost-effective that programs which require comprehensive governmental reviews and approvals. However, public access to the plans and simple reporting hold facilities accountable. For example, medical facilities must submit annual progress reports to the state and the rules allow the state to review waste reduction plans and enforce them when necessary. A filing fee associated with the annual reports helps support the state's medical waste regulatory program.

Deadlines for medical facilities to implement their plans were staggered according to the amount of waste generated; those generating more than 500 lb/mo were to have implemented their plans in 1995, those generating 200 to 500 lb/mo in 1996, and those generating 50 to 200 lb/mo in 1997. Staggered deadlines ensured that the largest generators would reduce wastes right away and gave smaller medical facilities incentive to comply with the intent of the rule early so they could delay or eliminate the need for paperwork and fees later.

Medical waste reduction plans Medical facilities generating more than fifty pounds of medical waste a month must write and implement plans to reduce medical waste generated by their facility. Based on prior experience with toxic reduction and waste reduction in hospitals, the rules specify a process that promotes material management rather than an analysis of end-of-life disposal options. Medical facilities are encouraged to improve no matter where they are in the process and to look at ALL wastes, not just medical waste. The rule does not punish those who had already done a lot to reduce waste. Rather than mandate percentages of reduction or statewide numerical goals, the rules require each medical facility to set its own goals and choose how to meet the goals within its own context.

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Simply put, a medical waste reduction plan is a working internal document which describes how the medical facility has managed waste in the past and how it will reduce waste in the future. Every medical waste reduction plan must include the following 7 components, which are common to successful waste reduction programs of all kinds:

(1) Setting specific goals and objectives, including a self-chosen numerical goal for infectious waste generation.
(2) Describing past practices and "baseline" (current) practices.
(3) Improving waste management practices.
(4) Examining alternatives to disposable items.
(5) Educating those who generate waste (employees and the public).
(6) Monitoring progress and submitting progress reports to DNR.
(7) Identifying who is responsible for implementing the plan.

Facility administrators must sign annual reports to DNR to ensure top management support for continuing waste reduction efforts. The plans are publicly accessible, which enables local citizens and environmental groups to encourage medical facilities to reduce waste.

Implementation Medical facilities are now implementing waste reduction plans supported by the University of Wisconsin Extension, the state Department of Natural Resources, environmental groups and other organizations. Substantial changes in the management of medical materials have occurred throughout the state, such as:

- Most medical waste is now being treated by non-incineration methods. Fewer than five Medical facilities are still operating incinerators and, at this time, none of Wisconsin's commercial incinerators are operating. This has undoubtedly improved air quality in Wisconsin.

- Less waste needs to be incinerated or specially treated. Reductions in medical waste of 20 to 50% are common in medical facilities across the state and vary depending on previous waste reduction efforts.

- Most medical facilities (unless exempt) have implemented waste reduction plans and begun reporting their progress to the state. As a result, many have saved substantial amounts of money and diverted wastes from landfills.

- Although most reductions in medical waste appear to be due to source separation alone, some is due to material substitution and other waste reduction strategies.

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- More materials from medical facilities are being recycled. Most medical facilities are separating wastes and complying with Wisconsin's recycling law. Those with waste reduction plans are able to reassure potential materials recyclers about the quality and safety of their recyclables.

The partners are now working on resolving non-regulatory challenges to waste reduction.

Challenges Efforts to reduce and recycle medical materials have been hampered by a variety of challenges. With support from the WI Recycling Market Development Board, an environmental organization brought together everyone who handles a product through its life cycle from medical suppliers to processors of recycled materials. This group identified the challenges and some potential solutions to implement successful medical waste reduction policies.

In all, forty-four issues were identified. Both the interviews and the focus group results indicate that a challenge for one part of the chain is often a challenge for another. The focus group prioritized the challenges down to nine.

Nine Priority Issues Identified by the Focus Group (December 1995):
- Finding a separation process, containers, and internal storage space for products.
- Fostering communication among all players -- people who produce packaging, end-users, etc.
- Committing to recycling in hospitals.
- Creating a system for identifying products and materials.
- Stimulating markets for certain materials.
- Reducing the stigma associated with medical waste.
- Emphasizing quality control in source separation and minimizing contaminants.
- Creating economies of scale through contracts for purchasing and disposal.
- Recognizing that needs of hospitals vary by type of facility and geographic area.

The group focused on these nine challenges, generating solutions that covered the breadth of the material management chain. In March 1996, representatives from medical facilities, state agencies, vendors and environmental groups convened to discuss the challenges and to help each other meet the new state requirements. The publication, *Closing the Loop: How to Reduce, Reuse and Recycle Medical Materials*, printed June 1998, captures the results of this work.

None of the challenges posed an absolute barrier to reducing, reusing or recycling medical materials. Communication and education surfaced as a main challenge both within a medical facility and between the different stages of the material management chain. Solutions have been identified for all the priority challenges. Significantly, the solutions gleaned from the participants in the project, either tried and tested or new ideas, lie within the medical sector and the medical material chain. Few solutions called for government action or involvement.

Future In order to continue Wisconsin's progress, we are:

- Analyzing the changes that have taken place to determine how successful waste reduction efforts have been and how to improve them.
- Integrating waste reduction planning with facility environmental management systems and Total Quality Management strategies.
- Eliminating the use of mercury in health care.
- Considering additional policies and regulations.

Copies of Ch. NR 526 may be obtained from the DNR or by directing your web browser to http://www.legis.state.wi.us/rsb/code/ Click on "Get Acrobat Reader" to download the software you'll need to read the rules. Click on "Natural Resources," click on "Chs. 500-590," click on "NR 526."

Barbara B. Derflinger *is the Medical Waste Coordinator for the Wisconsin Department of Natural Resources and has been for 6 years. She is responsible for writing and implementing the state's rule for managing and reducing medical waste. She earned a masters degree in geology (hydrogeology) from the University of Wisconsin - Madison in 1983 and a bachelors degree in geology from Winona State University in Winona, Minnesota, in 1979. Contact her at: Wisconsin Department of Natural Resources, 101 South Webster Street, Madison, Wisconsin 53707-7921. Phone: (608) 238-9934.*

Elizabeth Wessel *works independently as an Environmental Policy Specialist from her home. She has worked in multi-stakeholder partnerships at the national and state level to promote sustainable manufacturing and waste reduction. Ms. Wessel earned an M.Sc. in Regional and Urban Planning with a specialty in Natural Resources Management from the London School of Economics and Political Science, London, England and a B.S. in Biology and Environmental Studies from Saint Lawrence University, Canton, N.Y. Contact her at 546 Woodside Terrace, Madison, WI 53711. Phone: (608) 238-9934. E-mail: lwessel@itis.com.*

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Getting to Zero

Abstract

Under the Great Lakes Initiative (GLI), water quality standards designed to minimize the discharge of persistent toxic substances into the Great Lakes basin, wastewater treatment plants in the Great Lakes basin will soon be required to meet stringent mercury discharge limitations. To meet these limitations, hospitals discharging a Publicly Owned Treatment Works (POTW), may be required to reduce or eliminate their discharge of mercury. The use of mercury containing equipment and the use of mercury containing fixatives are large sources of mercury to wastewater discharge. Once a hospital has replaced its mercury containing equipment, the use of mercury containing fixatives in tissue preparation remains a source of mercury contaminated wastes. Pollution prevention practices, such as the use of mercury free fixatives, and proper management of these wastes can reduce or eliminate this source of mercury discharge. Pollution prevention efforts are more likely to succeed if they include recognition of barriers to change.

James Harvie *is an engineer at the Western Lake Superior Sanitary District. Western Lake Superior Sanitary has been directly involved in dental mercury discharge programs. He has been involved in various mercury and dioxin reduction initiatives. He can be contacted at Western Lake Superior Sanitary District: Zero Discharge Project, 2626 Courtland Street, Duluth, Minnesota 55806-1894. Phone: (218) 722-3336. Fax: (216) 727-7471.*

Section 7: Resource List

Resource List

This is a list of resources which may be used to assist those who wish to implement pollution prevention and compliance programs at different types of medical, laboratory, and dental facilities.[*]

EPA publications listed here can be ordered through your EPA regional office or accessed at http://www.epa.gov.

General Medical Facility Resources

Organizations

Carelift International, Inc. is a nonprofit 501 (c) 3 organization providing medical relief to the world's needy. The organization has developed four distinct programs to reclaim and reuse medical equipment, supplies and pharmaceuticals that are currently being disposed into the solid waste stream. For more information on donating excess inventory to Carelift International, call (610) 617-0995 or fax (610) 668-0930. Their address is Carelift International, Inc., GSB Building, 1 Belmont Ave., Suite 425, Bala Cynwyd, PA 19004.

Second Nature – Education for Sustainability is a nonprofit organization working to help colleges and universities expand their efforts to make environmentally sustainable and just action a foundation of learning and practice. Education for Sustainability (EFS) is a lifelong learning process that leads to an informed and involved citizenry having the creative problem-solving skills, scientific and social literacy, and commitment to engage in responsible individual and cooperative actions. Second Nature focuses on colleges and universities because they educate our future teachers, leaders, managers, policy makers, and other professionals. Contact Second Nature, 44 Bromfield St., Fifth Floor Boston, MA 02108-4909, Phone: (617) 292-7771, Fax: (617) 292-0150,
E-mail: info@2nature.org.

The Sustainable Hospitals Project of the Lowell Center for Sustainable Production at the University of Massachusetts Lowell provides health care personnel with tools, training, and technical support to improve the environmental practices of hospitals. The *Sustainable Hospitals Clearinghouse* provides timely, accurate, and useful about alternative products that do not contain polyvinyl chloride (PVC), mercury, and other potentially harmful materials. The *Clearinghouse Library*, housed at the Technology Transfer Center of the Toxics Use Reduction Institute, University of Massachusetts, Lowell specializes in alternative products research and alternative product sources for the healthcare industry. The *Training Program* will educate and train hospital personnel about the need for reducing the use of harmful materials and processes, and provide them with concepts, techniques, and strategies for doing so. Contact the Clearinghouse Library through the Toxics Use Reduction Institute at the University of Massachusetts Lowell, One University Avenue, Lowell, Massachusetts 01854. Phone: (978) 934-3346. Fax: (978) 934-3050.

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[*] Inclusion in this resource list does not constitute endorsement or approval of these sources of information or technical help by any of the sponsoring agencies or cooperating organizations of this conference.

The Sustainable Hospitals Project of the Great Lakes Center for Occupational and Environmental Safety and Health at the University of Illinois' School of Public Health is a technical resource, information clearinghouse, and educational outreach effort for Chicago area and Illinois hospital and health care institutions, public health advocates, regulatory agencies, labor groups, health impacted constituencies, and health care providers on issues related to hospital pollution prevention. Contact Scott Sederstrom, Sustainable Hospitals Project, Great Lakes Center for Occupational and Environmental Safety and Health, University of Illinois School of Public Health, 2121 W. Taylor Street M/C 922, Chicago, IL 60612-7260. Phone: (312) 355-0780. Fax: (312) 413-7369. E-mail: sseder1@uic.edu

Remedy (Recovered Medical Equipment for the Developing World) is a safe and efficient method for the recovery of opened, but unused materials from the operating room that began in 1991 at the Yale-New Haven Hospital in New Haven, CT. Instead of being discarded, these materials are collected and, through hospital-charity partnerships, shipped to developing countries where they are so desperately needed. Contact Darryl Kuperstock, 333 Cedar Street, P.O. Box 20805, New Haven, CT 06520-805. Phone (203) 785-2802. Fax (203) 785-6664. E-mail: REMEDY@Biomed.Med.Yale.edu. Website: http://gasnet.med.yale.edu/~remedy.

Southeast Michigan Outreach - Outreach to hospitals to reduce mercury in products and waste streams. Contact Guy Williams, National Wildlife Federation. (313)769-3351.

Southeast Michigan Medical Mercury Outreach - Outreach to medical waste incinerators and their customers on how to reduce mercury in hospital and medical waste. Contact: Steve Kratzer, Michigan Department of Environmental Quality. (517) 373-0939.

The Toxics Action Center is a non-profit environmental organization which assists citizens working to prevent waste and pollution in their communities. Our resources include *Preventable Poisons: A Prescription for Reducing Medical Waste in Massachusetts*, a report co-authored with the Greater Boston Physicians for Social Responsibility. Contact Eric Weltman at (617) 292-4821.

Wisconsin Medical Mercury Project: Provide assessments at hospitals and medical facilities. Services also include outreach, information, and technical assistance. Contact University of Wisconsin Extension, Solid and Hazardous Waste Education Center at (608) 227-3160.

Books

Environmental Management in Healthcare Facilities, edited by Kathryn D. Wagner (1988 W.B. Saunders Company).

Generations at Risk: How Environmental Toxins May Affect Reproductive Health in Massachusetts by Ted Schettler, MD, MPH (1996 Physicians for Social Responsibility).

Medical Waste Disposal by Calvin R. Brunner (1998 Incinerator Consultants Incorporated).

An Ounce of Prevention: Waste Reduction Strategies for Health Care Facilities (1993 American Society for Healthcare Environmental Services), and companion *Guidebook for Hospital Waste Reduction Planning and Program Implementation* (1996 American Society for Healthcare Environmental Services). To order, contact the Environmental Services of the American Hospital Association, One North Franklin, Chicago, IL 60606. Phone: 1-800-242-2626. Fax: (312) 422-4505.

Pollution Prevention for Health Care Facilities by Hollie Shaner. (1997 American Society for Healthcare Environmental Services). To order, contact the Environmental Services of the American Hospital Association, One North Franklin, Chicago, IL 60606. Phone: 1-800-242-2626. Fax (312) 422-4505.

Becoming a Mercury Free Facility: A Priority to be Achieved by the Year 2000 by Hollie Shaner. 1997 Professional Development Series of the American Society for Healthcare Environmental Services). To order, contact the Environmental Services of the American Hospital Association, One North Franklin, Chicago, IL 60606. Phone: 1-800-242-2626. Fax: (312) 422-4505.

Reports, Educational Booklets & Brochures

Best Management Practices for Hospitals & Medical Facilities Booklet with fact cards, from the Palo Alto Regional Water Quality Control Plant Medical Project. Call Ken Torke at (415) 329-2598 or (415) 329 2421.

The Case Against Mercury: Rx for Pollution Prevention (1995 Terrene Institute, in cooperation with the US Environmental Protection Agency Region 5, Chicago, IL). This brochure introduces readers to the dangers of mercury in the environment, to alternatives for mercury in a health care setting, and to proper management of used mercury or mercury spills.

Closing the Loop: How to Reduce, Reuse, Recycle Medical Materials (1998, The Wisconsin Office of Citizens for a Better Environment). This publication examines the medical material chain, identifies key challenges faced in reducing, reusing, and recycling materials and offers suggestions on successful solutions. Copies are available from

Citizens for a Better Environment, 152 W. Wisconsin Ave, Suite 510, Milwaukee, Wisconsin 53203. Phone: (414) 271-7280. Copies are also available from the Medical Waste Coordinator, Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, Wisconsin 53707-7921.

First, Do No Harm: Reducing the Medical Waste Threat to Public Health and the Environment (1997, The Environmental Working Group/The Tides Center). This publication contains a series of state-level reports with a national overview, and is a product of a collaborative public education effort by members of *Health Care Without Harm: The Campaign for Environmentally Responsible Health Care.* Copies are available at http://www.ewg.org or by contacting Health Care Without Harm, CCHW, PO Box 6806, Falls Church, Virginia 22040. Phone: (703) 237-2249.

Guidebook for Hospital Waste Reduction Planning and Program Implementation (1996 The American Society for Healthcare Environmental Services). This is the companion guide to *An Ounce of Prevention* and provides you with tools, guidelines, and information to help you navigate through the regulatory and financial maze associated with establishing a waste management program for your facility. To order, contact the Environmental Services of the American Hospital Association, One North Franklin, Chicago, IL 60606. Phone: 1-800-242-2626. Fax: (312) 422-4505.

Guides to Pollution Prevention: Selected Hospital Waste Streams (1990, US Environmental Protection Agency). This guide provides an overview of hospital waste generating processes and presents options for minimizing waste generation through source reduction and recycling.

Hospital Plastics Characterization and Recycling Feasibility Study (The Society of the Plastics Industry, Inc.) Contact 1275 K Street, NW Suite 400, Washington, DC 20005. Phone: 800-2-HELP-90.

Hospital Waste Reduction Checklist, 1996. A 14 page guide by the Wisconsin Solid and Hazardous Waste Education Center. Contact University of Wisconsin Extension Solid and Hazardous Waste Education Center at (608) 227-3160.

Hospital Waste Reduction; A Step-by-Step Guide to a Healthier Environment. Contact the New Jersey Hospitals for a Healthy Environment 760 Alexander Road, CN-1 Princeton, NJ 08543-0001. Phone: (609) 275-4000.

Implementation of the Mercury-Containing and Rechargeable Battery Management Act. This 1997 booklet by the United States Environmental Protection Agency explains what the Mercury-Containing and Rechargeable Battery Management Act (the Battery Act) means to you. It includes a summary of previous state and federal requirements that affected battery recycling, a summary of the Act's requirements, why proper disposal or recycling is necessary for Ni-Cd and SSLA batteries, and finally, state, local, and private-sector initiatives to recycle used rechargeable batteries.

Massachusetts Water Resource Authority/Medical, Academic, and Scientific Community Organization Hospital Mercury Workgroup Reports, Guidebooks, and Manuals are available from MASCO. Contact David Eppstein at (617) 632-2860 or find them at www.masco.org/mercury.

Medical Waste Pollution Prevention Fact Sheets(US EPA, Region 5):
- Keeping Mercury Out of Medical Waste
- Use of Alternative Products
- Keep Mercury Out of the Waste Water Stream

For copies call Chris Urban, US EPA, Region 5 at (312) 886-3493.

Mercury in the Health Care Sector: The Cost of Alternative Products. This report compares the cost of mercury containing equipment and products with non-mercury alternatives at hospitals. (Cost $17.) Contact Pollution Probe at (416) 926-1907.

Mercury Use in Hospitals & Clinics by the Minnesota Office of Environmental Assistance. This handout is excerpted from the Wisconsin Mercury Source Book and adapted for Minnesota hospitals and clinics. Includes information on mercury-containing products unique to hospitals and clinics, case studies describing source substitution experiences, and action ideas for pollution prevention, recycling, and management practices for a hospital or clinic. A good overview of the types of mercury-containing products and alternatives that may exist in hospitals and clinics is also provided. Contact: Minnesota Office of Environmental Assistance at 520 Lafayette Rd., 2nd Floor St. Paul, MN. Phone: (612) 296-3417 or 800-657-3843.

Mercury Pollution Prevention in Healthcare: A Prescription for Success (1997 National Wildlife Federation). Available from NWF, National Wildlife Federation, Great Lakes Natural Resource Center 506 E. Liberty, 2nd Floor, Ann Arbor, MI 48104-2210. Phone (313) 769-3351 or on the web at www.nwf.org. This booklet has a good background on the mercury problem and a list of resources.

The New England Healthcare System VISN 1: Recycling Pilot Program March 1, 1997 by Thomas E. Adamowich and David J. Maine. Edith Nourse Rogers Memorial Veterans Hospital, 200 Springs Rd. Bedford, MA 01730. This facility went from recycling two tons a month of corrugated cardboard, white paper, newspapers and magazines to 8 tons of materials a week.

Pollution Prevention for Hospitals and Medical Facilities Palo Alto Regional Water Quality Control Plant Medical Project. Call Ken Torke at (415) 329-2598 or (415) 329 2421.

Pollution Prevention Workshop and Resource Guides, 1996. Designed for staff, management and/or owners, as well as suppliers, the guides summarize key workshop materials and provide the basis of practical pollution prevention as applied to typical operating activities of industrial and institutional sectors, including the hospital community. (Price: $20.00 plus $7.50 shipping). Contact the Canadian Center for Pollution Prevention at 1-800-667-9790.

Preventable Poisons: A Prescription for Reducing Medical Waste in Massachusetts (1997 Greater Boston Physicians for Social Responsibility and the Toxics Action Center) Principal authors are Ted Schettler, MD, MPH, and Eric Weltman, MA. Please call the Toxics Action Center at (617) 292-4821 for this $5.00 booklet.

Silverbulletin: Mercury Pollution Prevention Education Project is a brochure developed by Erie County, Department of Environment and Planning. Call (716) 858-6370 at Environmental Compliance Services, 95 Franklin Street, Buffalo, NY 14202. Elevates mercury awareness and encourages voluntary pollution prevention activities in Erie County.

Waste Management Manual of the Mary Hitchcock Memorial Hospital and the Hitchcock Clinic, New Hampshire. This manual was written by the Safety and Environmental Programs Office for the Lebanon campus of Dartmouth-Hitchcock Medical Center (DHMC) and provides specific guidelines for DHMC's waste management plan and the tools for compliance, education, and training. It also provides a management and disposal methods for laboratory, pathological, radioactive, and infectious wastes. It is available from the Dartmouth-Hitchcock Medical Center. Phone: 603-650-7488.

Waste Management for Health Care Facilities by Linda D. Lee, MS (1992 American Society for Hospital Engineering). This collection of resource documents is intended to assist hospital managers in establishing sound, cost-effective policies and procedures tailored to the needs of individual health care facilities. This series focuses on the broad, functional areas of facilities management and includes volumes on waste management, emergency preparedness, hazard communication/right-to-know, electrical systems, mechanical systems, planning and design, and construction management. Contact the American Society for Hospital Engineering, 840 North Lake Shore Drive, Chicago IL 60611.

Water Pollution Reduction Practices: How Hospitals and Health Care Facilities Can Prevent Pollutants from entering the South Bay November 1997. San Jose/Santa Clara (California) Water Pollution Control Plant. Major topics addressed are; sanitary sewer pollution prevention practices, wastewater flow reduction practices, and storm sewer (facility runoff) protection practices. Includes specific pollution prevention practices for areas such as patient wards, central sterilization, radiation therapy & nuclear medicine, and medicine disposal & pharmacies.

Articles Published in Periodicals

"The Accelerated Reduction and Elimination of Toxics in Canada: the Case of Mercury-Containing Instruments in Quebec Hospital Centres" by P. Guerrier et al. (1995 *Water, Air, and Soil Pollution,* Volume 80, pp. 1199-1202).

"Battling Environmental Concerns: How Physicians and Hospitals Can Work Together," by David C. Rosen, MD, (March 1996 *Canadian Family Physician*, Volume 42). In early 1990, the Department of Family Medicine at Credit Valley Hospital in Mississauga, Ontario passed a motion to recognize that environmental concerns are a public health issue and to establish a committee of physicians to examine waste management within the hospital.

"Dioxin and Medical Waste Incinerators" by Joe Thorton, Michael McCally, Peter Orris, and Jack Weinberg. (July/August 1996 *Public Health Reports*, Volume 3). An emerging body of information suggests that dioxin contamination has reached a level that may pose a large-scale, long-term public health risk. Of particular concern are dioxin's effects on reproduction, development, immune system function, and carcinogenesis. Medical waste incineration is a major source of dioxins. Health professionals have a responsibility to work to reduce dioxin exposure from medical sources. Health care institutions should implement policies to reduce the use of PVC plastics, thus achieving major reductions in medically related dioxin formation.

"Dissolving Medical Waste" Brandy E. Fisher. (July 1996 *Environmental Health Perspectives*, Volume 104, Number 7). Alternative waste disposal methods leads to using disposable healthcare products such as OREX, a hot-water-soluble polyvinyl alcohol (PVA). PVA is a nontoxic synthetic polymer, and is used to make products such as surgical gowns, towels, patient drapes, sponges, bowls, basins, and diapers.

"EPA On Track to Issue Burn Rule This Month" by Dee NaQuin. (July 1997 *Waste Age*). The US EPA has finally passed their regulations "affecting large, medium, and smaller-scale burners operations, with separate pollution control requirements for each tier". This will force hospitals to reexamine their use of these incinerators, and to investigate other options.

"Green Medicine: Environmental Impact of Health Care" by Kathy S. Worton, MSC, D. (June 1995 *Canadian Family Physician*, Volume 41). Individual health is inextricably linked to the health and vitality of our families, communities, and societies. However, our ethos of patient care should also include the natural environment. Environmental health can influence our spiritual, emotional, and physical well-being. Whether in your own office or your local hospital, the three R's - reduce, reuse, and recycle - provide a practical approach to waste management.

"Hospitals Agree to Clean Up Wastes" by Deanna Bellandi. (June 29, 1998 *Modern Healthcare Magazine*). Article discusses the signing of the memorandum of understanding between the American Hospital Association and the US Environmental Protection Agency. This memorandum calls for the virtual elimination of mercury from hospital waste by 2005.

"Invisible Costs, Visible Savings: Innovations in Waste Management for Hospitals" by Hollie Shaner and Glenn McRae (April 1996 *Surgical Services Management*, Volume 2 No. 4). Discusses regulated medical waste, segregating waste, the economic impact of waste to hospitals, and reducing costs and increasing safety.

"Medical Waste in the Environment: Do Anesthesia Personnel Have a Role to Play?" By Michael E. Goldberg (MD), et al. (1996 *Journal of Clinical Anesthesia*, Volume 8). A feasibility study of the mechanics of recycling single-use anesthesia breathing systems and practices of anesthesiologists and nurse-anesthetists in a tri-state region. It consisted of a two-part, open, prospective analysis using pre-printed questionnaires and cost/time analysis of labor and materials. Survey was sent to 413 anesthesiology departments in Pennsylvania, New Jersey, and Delaware, and a hospital/recycling facility for evaluation of time and cost.

"Medical Waste Comes of Age" by Michael Malloy. (July 1997 *Waste Age*). A new federal rule curtails on-site burning of medical waste at hospitals from 50-80%. This has already increased competition for disposal alternatives and treatment of regular medical waste (RMW) is becoming extremely diverse.

Educational Videos & Other Resources

ANA Pollution Prevention Tool Kit for Nurses - This kit was designed for State Nurses Associations (SNAs) to assist nurses (staff, executive, community health) and local bargaining unit leaders to become active in reducing the toxic pollution created as a byproduct of the health care industry. The kit is filled with resources for nurses to be involved in their own work site and community. Call 1-800-637-0323 or (3010 645-6202 and request item #9811LA. Cost is $79.95 List Price/$55.95 SNA Member Price, or $47.95 SNA Discounted Price. A special version contains the *Greening Hospitals* report conducted by Health Care Without Harm, and the video *The Healthcare Industry's Impact on the Environment: Strategies for Global Change*.

The Healthcare Industry's Impact on the Environment: Strategies for Global Change (video). This independent study module includes two 60-minute videos, continuing education information, and a study guide that contains a post-test, post-test answers and explanations, and additional resources and references. It was designed to assist you in recognizing the toxicity of dioxin and mercury. It is also designed to motivate you to change the way you procure, use, and dispose of medical supplies; educate patients about the health effects of environmental pollution; and advocate for minimization of medical waste incineration in their communities, states, and the nation. Contact the University of Vermont, Continuing Education, 30 South Park Drive, Colchester, VT 05446.
Phone: 1-800-639-3188 or (802)-656-2088.

Natural Rubber Latex Allergy: Recognition, Treatment, and Prevention (video).
This independent study module, Natural Rubber Latex Allergy: Recognition, Treatment, and Prevention, includes a 61 minute video, continuing education information, and a study guide that contains a post-test, post-test answers and explanations, and additional resources and references. It was designed to assist you in recognizing latex allergy as a significant health problem and in developing strategies to prevent allergic reactions in patients and workers who use or come in contact with products containing natural rubber latex, as well as to prevent further sensitization these individuals. Contact The University of Vermont, Continuing Education, 30 South Park Drive, Colchester, VT 05446.
Phone: 1-800-639-3188 or (802) 656-2088.

No Time to Waste - Video written by Hollie Shaner, RN, and Glenn McRae, of CGH Environmental Strategies, and produced by Fanlight Productions (Ann Carol Grossman & Ben Achtenberg). Focuses on the creative efforts of hospital staff, demonstrating a variety of ways hospitals everywhere can reduce waste and save money simultaneously. Study Guide included with the 30 minute video. Cost is $250, Rental is $50/day.
Contact CGH Environmental at 1-800-937-4113 and refer to catalog #LL-156, or
Fax: (617) 524-8838

Websites

Http://www.epa.gov/grtlakes/seahome/mercury/src/alternat.htm. This site lists alternative mercury-free medical products.

Http://www.epa.gov/grtlakes/seahome/mercury/src/mercmed.htm is a web site about mercury in medical institutions.

Http://www.epa.gov/seahome/mercury/src/title.htm - A web site and software developed by Purdue University and the US EPA entitled *Mercury Use Reduction and Waste Prevention in Medical Facilities*. This software is designed to assist medical professionals reduce the use of mercury in hospitals.

Http://www.epa.gov/mercury/src/may *Mercury Management at Mayo Clinic* February 13, 1997. Contact David H. Senjem, Environmental Safety Coordinator. Discusses Mayo clinic's continued efforts to further investigate and reduce the presence of mercury in their hospital. Heavy metal analysis is incorporated in certain product purchases and similar evaluations in certain large components of Mayo's incinerated waste stream. And, they have continued educational efforts.

Http://www.noharm.org The home page for the Health Care Without Harm campaign provides links, resources, and contact information.

Http://www.masco.org will link you to all the documents from the MWRA/MASCO hospital mercury workgroup, including the alternative products database.

Http://www.healthcare-environet.com/about.html - Healthcare Environet is a network of healthcare and environmental organizations committed to the promotion of sustainable development in healthcare. They were established through funding from Environment Canada and the Ontario Ministry of Environment and Energy, and is developed in consultation and partnership with healthcare and non-government organizations.

Http://www.ewg.org/pub/home/reports/greening/greenpr.html - The Environmental Working Group's website listed a June 9th press release titled *Hospitals Need "Green Overhaul, Survey Finds* - Medical Waste Burners Contaminate Baby Food With Dioxins, Fish With Mercury. Some Premier Hospitals Are Cleaning Up, But Most Are Just Starting. This Washington, DC organization says that a new study has found lack of basic environmental practices at major US hospitals is resulting in serious pollution problems and contamination of major foods, including baby foods.

Http://igm.nlm.nih.gov - Internet Grateful Med, a product of the US National Library of Medicine (NLM) offers free assisted searching in MEDLINE and other MEDLARS databases via the world wide web. This database was created by the US National Library of Medicine.

Http://www.nwf.org or http://www.greatlakes.nwf.org *Mercury Pollution Prevention in Healthcare: A Prescription for Success* July 1997. This guide is intended to offer guidance to hospitals that are striving to become mercury-free. It is intended to help healthcare workers and citizens eliminate mercury from hospitals, doctors' offices and other healthcare facilities. It provides information on: 1) Mercury and its effects on people and the environment; 2) the importance of source reduction; 3) the healthcare industry's role in preventing mercury pollution; 4) the whys and hows of becoming mercury-free; and 5) success stories. Address: National Wildlife Federation, Great Lakes Natural Resource Center 506 E. Liberty, 2nd Floor Ann Arbor, MI 48104-2210. Phone: (313) 769-3351 Fax: (313) 769-1449

Http://www.uml/edu/centers/LCSP/hospitals/ The Sustainable Hospitals Project provides health care personnel with tools, training, and technical support to improve the environmental practices of hospitals. In addition to reducing environmental pollution produced by hospitals, the project also improves health and safety for hospital workers and involves them in identifying and controlling hazards. The project is organized by The Lowell Center for Sustainable Production, and draws on the resources and expertise of the University of Massachusetts Lowell, including the Toxics Use Reduction Institute (TURI) and the Department of Work Environment.

Http://uvmce.uvm.edu:443/hlthcare/waste.html provides information about a 1998 University of Vermont Teleconference, *The Health Care Industry's Impact on the Environment: Strategies for Global Change.* Speaker slides, video ordering information, and background information are all included.

Http://www.deq.state.mi.us/ead/p2sect/mercury - Michigan's Mercury (Hg) Pollution Prevention (P2) Home Page includes a link to Health Care Products Known to Contain Mercury & Alternatives.

Recent Press Coverage

Headline: "American Hospitals are Major Polluters Due to the Amount of Medical Waste that is Incinerated." Show: *The Osgood File*, Monday, June 29, 1998. Copyright 1998 Burrelles Information Services, CBS News Transcripts.

Headline: "Do Physicians Violate Their Oath?" By Amy Sessler, *The Boston Globe*. Sunday, March 22, 1998. City Edition, Section: North Weekly, Pg. 11.

Headline: "Environment-U.S.: Hospitals a Major Source of Toxic Pollutants" by Danielle Knight, *Dateline*: Washington, Tuesday June 9, 1998. Copyright 1998 Inter Press Service.

Headline: "EPA, Hospital Association Ally in Fight Against Mercury Pollution" by Peter Kendal (Environment Writer), *Chicago Tribune*. Thursday, June 25, 1998 Section: Metro Chicago, Page 4, Zone N.

Headline: "Medical Waste: Hospitals Add to Toxic Contamination Through Incineration, Group Charges" June 18, 1998 By Business Publishers, Inc., *Solid Waste Report*. Section: No. 25, Vol. 29. ISSN:0038-1128.

Headline: "Medical Waste Incineration Major Source of Environmental Mercury, EWG Says" in *Pesticide & Toxic Chemical News*. January 14, 1998, Vol. 26, No. 12. ISSN: 0146-0501.

Headline: "Medical Waste Incinerators to Close; Major Trash Firm Plans Switch from Burning to Sterilizing Hospital Debris" by Scott Allen, *The Boston Globe*. Wednesday, June 10, 1998, City Edition - Section: National/Foreign; Pg. A8.

Headline: "Survey Finds Hospital Waste Disposal Unsafe" June 9, 1998 by H. Josef Herbert, Associated Press. (Http://www.foxnews.com/health/060998/wastes.sml)

Laboratory Resources

Books

Pollution Prevention and Waste Minimization In Laboratories, edited by. Peter A. Reinhardt, K. Leigh Leonard, and Peter C. Ashbrook (1995 CRC Press).

Methods in Nonradioactive Detection, edited by Gary C. Howard.(1993 Appleton &

Lange).

Articles Published in Periodicals

"'Biodegradable' Liquid Scintillation Counting Cocktails" by Robert C. Klein and Edward L. Gershey. (October 1990 *Health Physics*, Vol. 59, No. 4 pp. 461-470).

"Radioactive Waste Management at a Large University and Medical Research Complex" by Joseph Ring, Frank Osborne, Jacob Shapiro, and Robert Johnson. (August 1993 *Health Physics*, Volume 65, Number 2).

"Recommendations for Radioactive Waste Reduction in Biomedical/Academic Institutions" by E. Party and E.L. Gershey (April 1989 *Health Physics* Volume 56, Number 4).

A Review of Some Available Radioactive and Non-Radioactive Substitutes for use in Biomedical Research by E. Party and E.L. Gershey (July 1995 *Health Physics* Volume 69, Number 1).

Reports, Guidebooks, & Brochures

Hazardous Materials in the Histopathology Laboratory: Regulations, Risks, Handling, and Disposal by Janet Crookham Dapson and Richard W. Dapson. Includes detailed explanations of environmental, health, and safety regulations (OSHA, EPA, & Canadian), chemical hygiene practices, and a chapter on pollution prevention. Data compiled on nearly 150 chemicals, and includes sections on consumer awareness and contacts for assistance. To order contact Anatech Ltd., 1020 Harts Lake Rd., Battle Creek, MI 49015. Phone: 1-800-262-8324.

Laboratories: Best Management Practices for Water Quality Protection, 1996. 11 pages. Palo Alto Regional Water Quality Control Plant Medical Project. Contact Ken Torke at (415) 329-2421.

Low-Level Radioactive Waste from U.S. Biomedical and Academic Institutions: Policies, Strategies, and Solutions by A. Wilkerson, R.C. Klein, E. Party, and E.L. Gershey. (1989, Annual Reviews, Inc.) The Rockefeller University, 1230 York Avenue, New York, NY 10021.

Websites

Http://esf.uvm.edu/labxl/
Lab XL: Performance Oriented Environmental Regulation for Labs "The purpose of this web page is to provide a clearinghouse for information related to performance-oriented laboratory environmental regulation reform. Its primary focus is the work of the Laboratory Consortium for Environmental Excellence (LCEE) to improve laboratory

environmental performance. We are doing this by exploring the development of environmental management systems, sharing ideas and information about training resources, and participating in the development of a Project XL program in collaboration with the EPA" (Project XL: EPA's route to regulatory Reform).

Dental Facility Resources

Reports, Educational Booklets & Brochures

Dentistry and the Environment, A Guidance Document Developed to Increase Dentist's Awareness of Environmental Impacts of Wastes from Dental Facilities, published jointly by the Massachusetts Water Resource Authority and the Massachusetts Dental Society, January 1998 Contact MWRA at (617) 241-2309 or E-mail: cbering@mwra.state.ma.us.

Mercury in Dental Facilities, a report from the Massachusetts Water Resource Authority, September, 1997. Contact MWRA at (617) 241-2309.
E-mail: cbering@mwra.state.ma.us.

Amalgam Waste, Reduction and Recycling, a brochure from the Michigan Dental Association. Contact MDA, 230 N. Washington Square, Suite 208 Lansing, MI 48933-1392. Phone: (517) 372-9070.

A Collection Program for Raw Mercury Supplies from Michigan Dentists, from the Detroit Water and Sewerage Department, September 1996. Contact: Joan Hughes. Phone: (313) 224-2104

Proper Management of Dental Mercury; & *Hazardous Waste Information for Dentists,* fact sheets from the Massachusetts Department of Environmental Protection. Contact: Judy Shope. Phone: (617) 292-5597.

Resource Guide: Useful Information for Properly Managing Your Dental Wastes May 1997. Prepared by the City & County of San Francisco, the Bureau of Environmental Regulation and Management, and the Water Pollution Prevention Program with the support of the San Francisco Dental Society & the California Dental Association. Contact 1-800-236-7071 X 4280.

"Possible Alternative Materials to Amalgam for the Restoration of Posterior Teeth," by B.M. Eley, (July 12, 1997, *British Dental Journal*).

Workshop Resource Guide: Pollution Prevention and Waste Management in the Dental Community. This document is $20.00 + 7.50 shipping and handling. Contact Deb Foster at the Canadian Centre for Pollution Prevention. Phone: 1-800-667-9790.

Controlling Mercury in Dental Wastes, Tufts University Capstone Project Report, expected by September 1998. Contact Tufts University at (617) 627-3211.

Websites

Http://www.metrokc.gov/hazwaste/estars - EnviroStars environmental achievement recognition program developed by King County. Includes reports on three dental facilities.

Http://www.wa.gov/ecology/hwtr/ brings you to Washington State Department of Ecology Hazardous Waste and Toxics Reduction Program page. Click on the Dental Recycling Manual link or go directly to **http://www.wa.gov/ecology/hwtr/97-436.pdf** to download the Portable Document Format version.

Http://www.dental-revision.org - A forum for open discussion of possible health hazards related to dental mercury amalgam fillings and other heavy metals used in dental treatment.

Http://141.211.226.92/health/service/oralinfo/mercury.html - *Mercury in Dental Amalgam, is it a Public Concern?* Literature Review, Proposed Audience and Content, Health Generalization and Objectives Methods, Proposed Evaluation Method, Considerations.

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